THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

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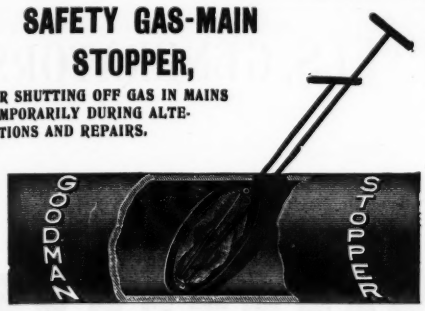

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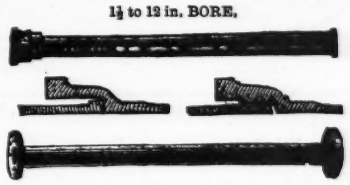

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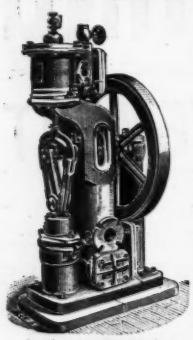

Fig. 705. "SINGLE RAM" STEAM-PUMP.

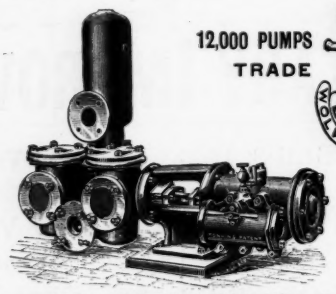

Fig. 598. "CORNISH," STEAM-PUMP FOR BOILER FEEDING, &c.

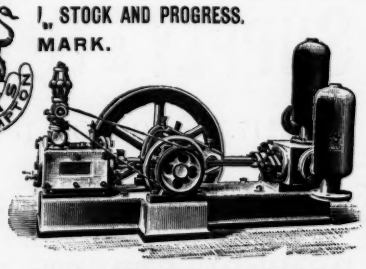

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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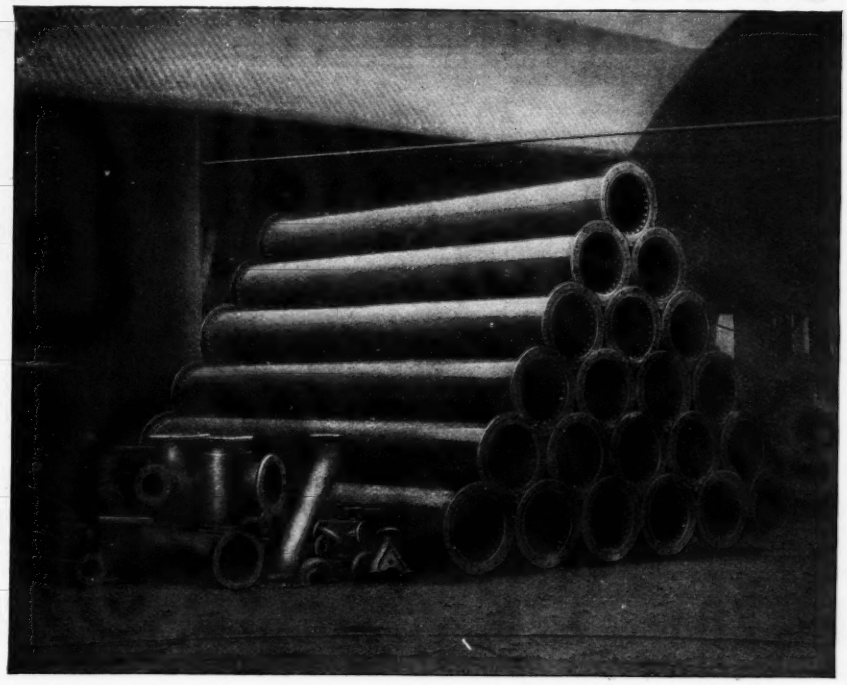

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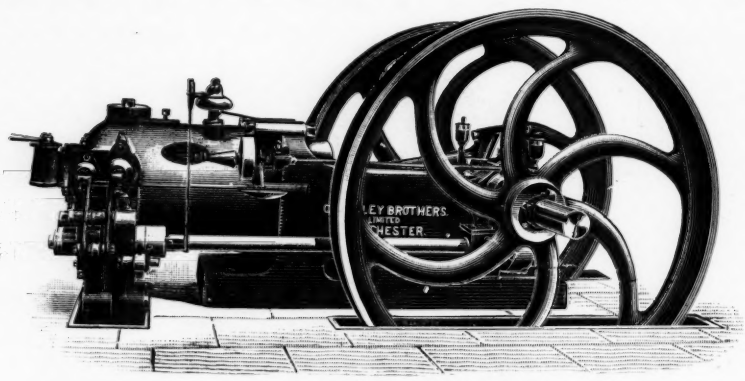

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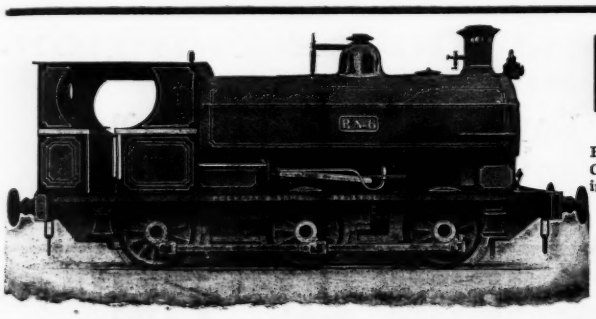

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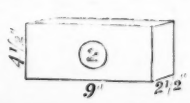

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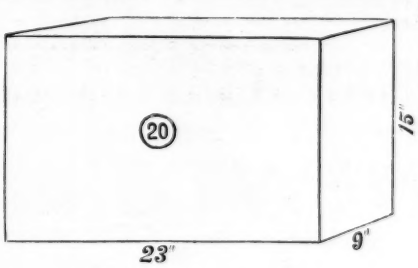

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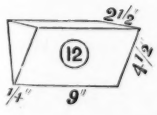

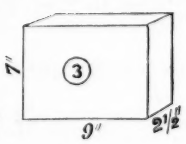

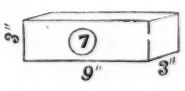

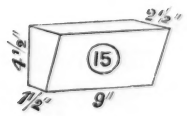

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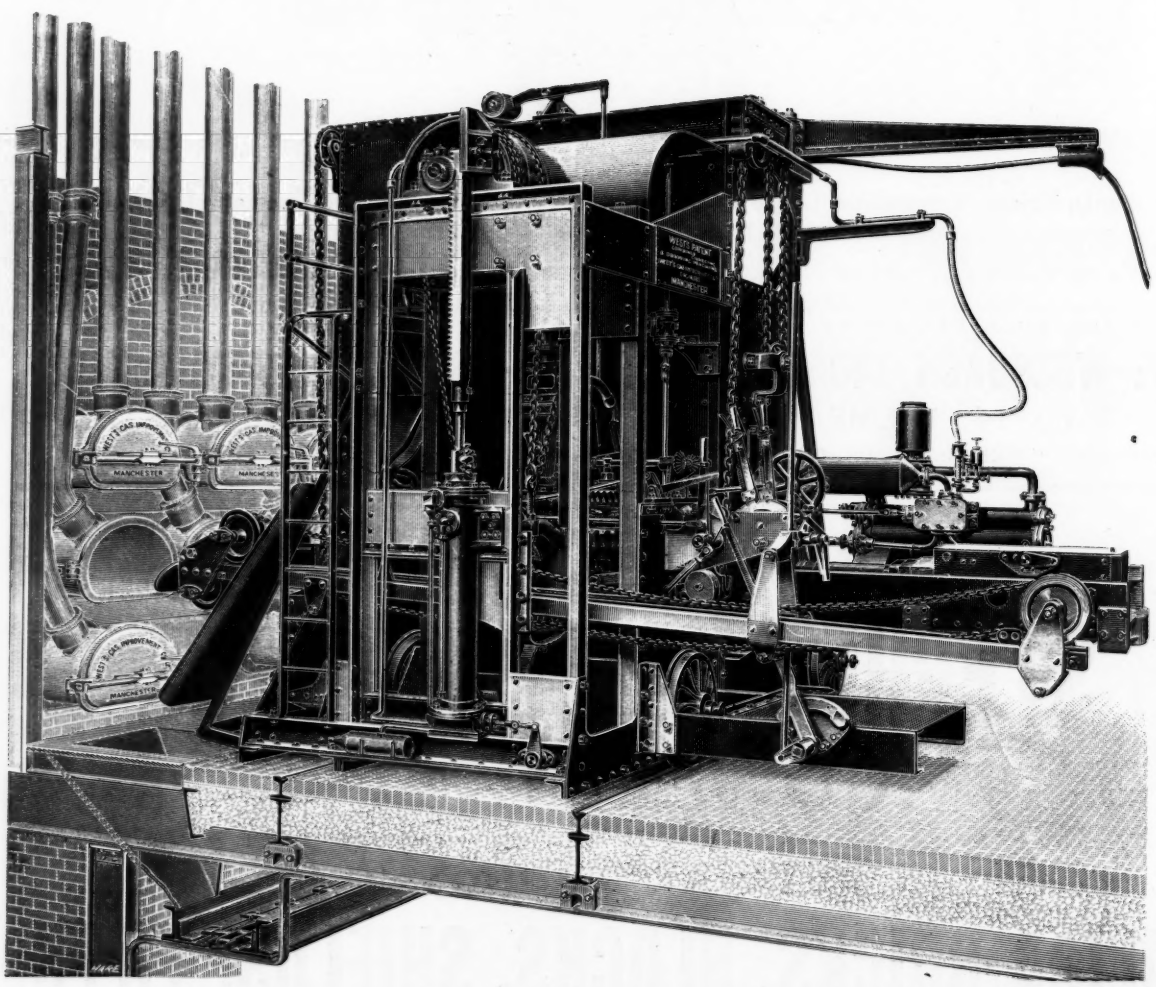

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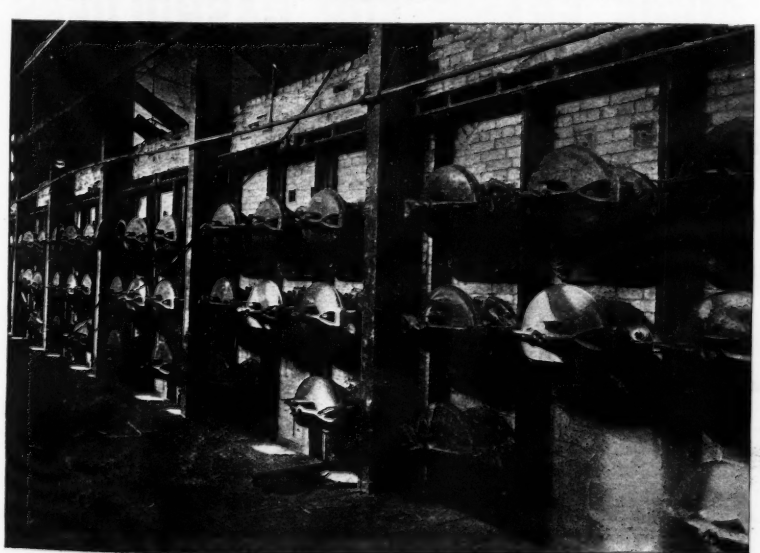

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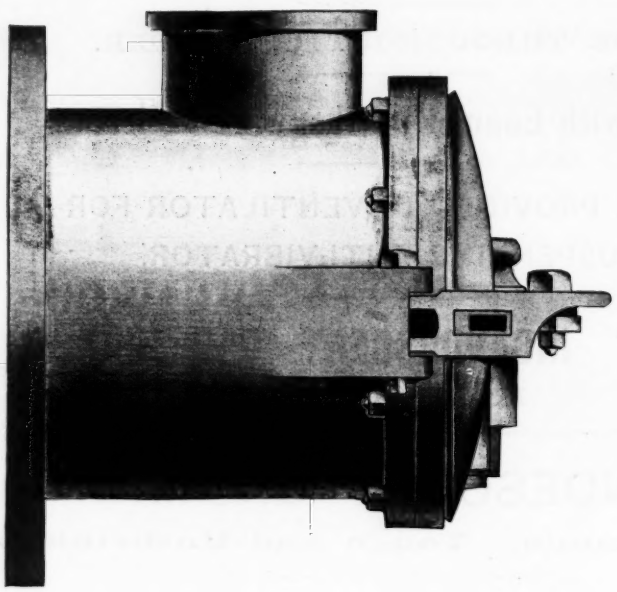

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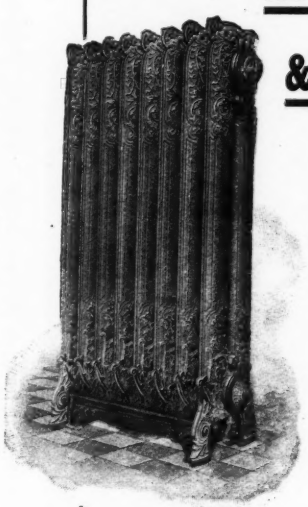

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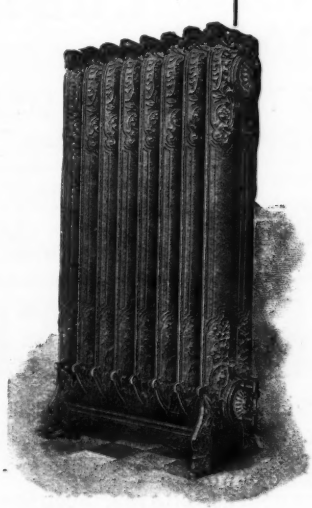

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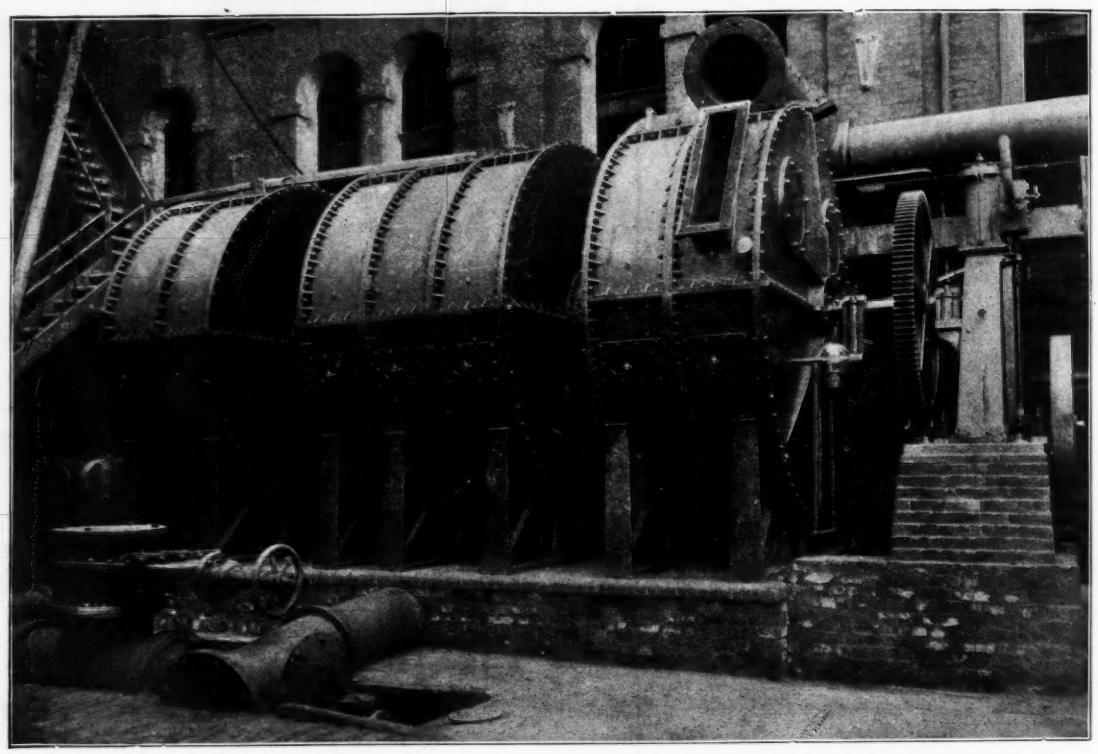

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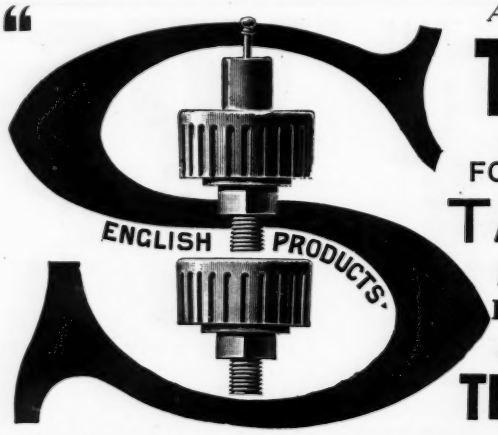

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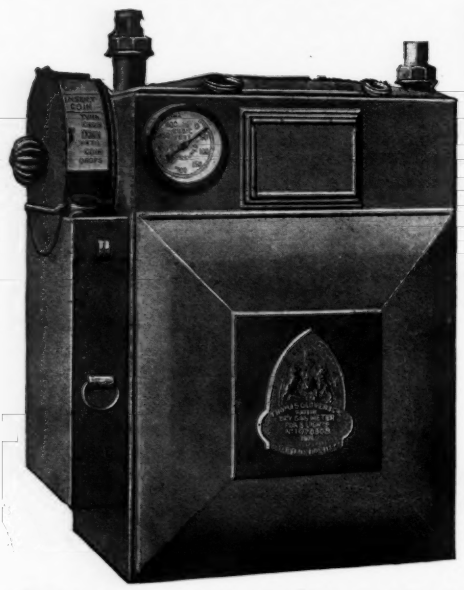

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EDITORIAL NOTES.

Coal Contracts and Combinations.

IT is announced in the South Wales newspapers that the negotiations, which have been for a long time in progress, for consolidating the anthracite interests, have been brought to a successful issue, and that the "International Anthracite "Association, Limited," has been "inaugurated," with a temporary office at Swansea. The declared object of this Association is that of imparting to the anthracite trade of South Wales "that steadiness, in respect both to produc- "tion and selling values, which regularity in the supply, "based on a well-regulated and constant outlet, can secure." It is a laudable object—indeed, it is the one desirable object of all the arrangements bearing upon the conduct of trade. Whatever the nature of such arrangement, whether it is a tariff or free trade, the imposition of a duty or its removal, a producers' Syndicate, or a workmen's Trade Union, the main purpose is still the same—regulation, with a view to steadiness of production and prices. Perhaps this is a thought which will not at first sight strike all observers of commercial organizations; but it is a light that grows from the moment it is perceived. There is not on the surface a great deal in common between a producers' Syndicate, or "Cartel," as the Germans call it, and the historic Anti-Corn-Law League. Yet careful students of the aims and operations of the League, and especially of the voluminous writings and speeches of Richard Cobden, its mainspring, know that the object of the League was to steady the price of corn by throwing open the home market for it, which was then dominated by the home producers. This is also ostensibly the purpose of the Anthracite Association; and it is an object which really has no basis in import or export duties, or anything extraneous to the conditions of the particular commerce itself. No wise trade organizer, by any means which lay to his hand, ever hoped to make more of the trade than legitimately belonged to it. His purpose always was to remove hindrances and abuses, not to create any artificial advantage. Rarely have the business men who form these large combinations ventured to force them into the service of that extreme form of trade manipulation which is called "cornering." Corners are by nature transient, and those which have succeeded even temporarily were mainly the enterprise of one man, or one group of men. Syndicates for the regulation of trade are nothing if not the opposite of cornering—that is to say, operative in the interest of all the associates, who must form the bulk of the trade or else the syndicate is still-born—and permanently effective.

Those who profess a firm belief in the merit of freedom of trade—which is a different thing from Free Trade—are not usually traders. By this term "freedom of trade" we mean the absolute independence of every dealer in a commodity to make the best terms for himself from the purchaser, who is equally free to buy anywhere and of anybody, to any extent necessary for the satisfaction of his wants. This is the ideal. But it is scarcely necessary to remark that the practice of every-day dealing is different. The free play of a desire to buy or sell—which seems a more intelligible and humanized statement of the operation of trading than the impersonal expression "the law of supply "and demand"—is restricted and regulated in all sorts of ways. It is unnecessary to labour this point, which must be accepted by everybody who has ever purchased a penny-worth of coal gas, or a railway ticket, or any consumable commodity. The first control of prices is usually, but not always, in the hands of the seller. Carry the thought a step farther, and assume that the sellers are also usually few in comparison with their possible customers. It immediately follows that the opportunity for combining with a view to their own advantage lies with the former. And how great is the inducement to do this! An absolutely unregulated trade—a trade in which there is unrestricted competition—is liable to violent fluctuations, which benefit nobody in the long run. When profits rule high, there is a rush into the business, which cuts the trade to nothing. Many industries have ceased to exist, not because their products were not in demand, but because it no longer paid to make them. A is a carrier between two places, who is just able to make a living. To him comes B, who divides the custom, and thus makes it unprofitable for both. Result, eventually, no carrier at all. This mischief is obviated in the great trade routes of the world by such regulation as led to the leading case of the Mogul Steamship Company. So we get back to the point from which we started—that regulation is the one thing desired by traders. Nor is it, if confined to reasonable bounds, injurious to buyers. The German coal and coke Cartels claim, for example, that they did not participate in the movement which made unregulated British coal so outrageously dear a couple of years ago.

If it may be assumed that the latest attempt to regulate the anthracite trade will succeed, the result will not be without some bearing upon the gas industry. The market for coke in certain places is directly affected by the price of anthracite—as, for instance, in connection with cement manufacture. To judge by the loud and deep complaints of gas managers when any number of them get together, something in the way of syndicating the gas coke trade would be welcomed, if it might be made available to stop the "dumping" of the product of large works in distant localities. It puts a severe strain upon the principles of any gas manager in a small way, who holds theoretically with freedom of trade, when he sees a train of "foreign" gas coke waggons in the local railway station yard. But all gas managers, whatever the scale of their particular affairs, are more deeply concerned still in the operation of gas coal and gas oil "rings." Let us all clear our minds of cant in this regard. This may be a Free Trade country; but nevertheless freedom of trade within its borders is as much to seek as it is in any land where "Trusts" and "Cartels" are avowed agencies for the regulation of production and prices. This patent fact is the cause of all the trouble about gas coal and other tenderings, which breaks out now and then in connection with the administration of British gas undertakings. It is due to the knowledge of "cornering" which cannot be hidden even from municipal buyers. The colliery people and the oil importers are no more blameworthy than other traders in respect of doing well for themselves whenever they have the chance; but it would be ridiculous for them to protest that they never attempt anything of the kind by private "arrangement." Doubtless, they would like all their customers to be bound to take whatever they agree to offer as regards quantities and prices. It is one of the practical drawbacks of municipal trading that Committees cannot bargain and make deals like private firms. The "JOURNAL" is commonly accused of being a narrow and prejudiced opponent of the principle of municipal trading. All the Progressive journals say so. We have often declared, and now repeat, that the *crux* of municipal trade is not in the principle, which is an abstraction, but in the practice, which is concrete business. We will therefore challenge our Progressive critics to scheme an executive for municipal undertakings as competent to deal with rings of tenderers as exists in the case of other traders.

The London County Council profess to be unable to place any check upon the formation of rings of builders and contractors for public works, except by the maintenance of a Works Department. Whether this supposed remedy is not worse than the disease against which it is exhibited, may be matter of opinion; but it is not difficult to imagine what would be likely to happen if the County Council had to buy all the gas coal for London. Rings are part of the atmosphere of trade, so to speak. They are the complement of the Trade Unions. Where both orders of organization subsist in full luxuriance, as they do in Chicago, according to all accounts, they naturally join their forces, for mutual advantage. Then the public suffer. What is the remedy? Certainly not municipalization, which would simply bring the rates to the support of both rings and Unions together. If the remedy is anything else than the sturdy individualism

in industrial affairs which seems to be passing away, or at any rate has no fascinations for the fuglemen of Progress, one would like to be made acquainted with it.

Gas-Engine Developments and Experiences.

For an excellent and readable review (within manageable limits for an engineer of little leisure) of the recent developments in the gas-engine, the paper which Professor D. S. Capper, Professor of Mechanical Engineering at King's College, London, read last Friday evening before the Junior Institution of Engineers, may be commended to notice. It is printed *in extenso* in the present issue, with an indication of the lines the discussion took which succeeded it. There are few men who have made a more exhaustive study of the gas-engine than Professor Capper; and it is a point of interest, in view of the fact that the Professor is engaged as reporter in connection with the Steam-Engine Research Committee of the Institution of Mechanical Engineers, to find him saying that the steam-engine has already been considerably surpassed in thermal efficiency by its younger rival, and that there are not wanting signs that, in practical convenience and general applicability, the steam-engine may ere long also yield the palm to the internal combustion engine. The last paragraph of the paper shows the direction in which Professor Capper is looking for further development. "Many experimenters are working on the problem "of the gas-turbine; and there are even rumours that a "solution has been found. There is little doubt that . . . "the gas-turbine will in the future, possibly the near future, "be an accomplished fact."

As intimated, owing to the length of both the paper and discussion, we are only able to trace, in the report, some of the lines along which the latter ran. There is one aspect of the discussion which should be mentioned. The number of members present was large; and it was clear that those who took part in the discussion were men who have the practical knowledge of gas-engines obtained from the daily responsibility of superintending their working, and such above all others are the men who know most of the merits and frailties of these engines. Mr. Samuel Cutler, jun., the Chairman of the Institution, must be congratulated on the character of the meeting in all respects; and at the same time mention should be made of the illustrated point in his speech as to the advantages which gas suppliers cannot fail to derive from adopting a liberal policy towards power users. Within a short distance of the works with which Mr. Cutler is identified, there are sixteen industrial establishments, mostly engineering, and thirteen of them use the gas of the Commercial Gas Company for motive power. He attributes this large capture of the power business of these works to the fact that the Company allow, for this purpose, a discount of 20 per cent. off the 2s. 6d. per 1000 cubic feet charged for other uses. Under such a condition, Mr. Cutler has weighed the *pros* and *cons* of ordinary gas supply and producer gas; and he finds that the balance is so equal that the firm with which he is associated prefer an unlimited supply of good gas made by someone else to tacking on to the operations of their works (which are quite sufficient to engage those responsible for their management) the inconvenience and trouble of producing an independent supply of poor gas. This is a point that managers of gas undertakings who have not considered it may with advantage turn over in their minds.

Smokeless Cooking Appliances.

The President of the Coal Smoke Abatement Society—Sir W. B. Richmond—has just given another sign of his official existence, in a letter to the newspapers on a subject of close and particular interest for all gas managers. The attention of the Society has been drawn to a recent decision of the Westminster City Council "to urge upon the London "County Council the desirability of undertaking an inquiry "into the methods of cooking, with the object of ascertaining whether there is any form of apparatus which is "smokeless, and at the same time practical and economical "for general use." Why, of course there is! The gas-cooking appliances employed in connection with the cookery instruction classes at South Kensington and in the Board Schools belong to this category. Without stopping to make this acknowledgment, however, Sir W. B. Richmond proceeds to pat the Westminster City Council on the back for their "useful proposal." Then he goes on to dilate in the familiar strain upon the evil of London smoke; stating that probably the greatest offenders are the kitchen chimneys, of which he reckons that there are 600,000 in London. On this, it is remarked very truly that "if the smoke from this "source were abated or absolutely removed, the gross out-"put of smoke would be enormously reduced." While Sir W. B. Richmond is upon this subject, he would be very well advised to ascertain what progress has actually been made in recent times in the reduction of this source of the evil complained of, and how it has been effected. These vague aspirations after an ideal of smokeless skies have been the bane of previous movements to that with which Sir W. B. Richmond has identified himself; and there appears to be, from his latest utterance, some risk lest he should fall into the same weakness of an amateurish detachment from the facts. Sir William won his spurs in this campaign against the smoke nuisance, not by indulging in declamation, but by valiantly tackling two offending chimneys in Hammersmith. It is the particulars that count in these matters.

Sir W. B. Richmond ought to recognize that during the past few years one apparatus—the gas-stove—has wrought an enormous change in the every-day aspect of the kitchen chimney-pot. It is only necessary to take a short morning journey by train along any of the high-level railways of London, to become convinced of the operation of something inside the houses to account for the absence of the remembered matutinal smoke, which was of a peculiarly choking and clinging character. If the painstaking officials of the London County Council do apply their attention to the inquiry suggested by the Westminster City Council, they can scarcely help giving its due to the gas stove, and particularly to the prepayment gas-meter stove. Sir W. B. Richmond observes that "if it were shown on the authority "of the London County Council that smokeless cooking "is economically possible and practicable, it would rapidly "become general." One is inclined to ask, Why? The householder, truly, objects to what he calls a smoky chimney; but he means by this a chimney that smokes at the wrong end. He has not any pecuniary or other interest in smokiness that does not annoy himself. The gas-stove is popular for the sake of its convenience, not for much else. Convenience, however, is everything in housekeeping. We wish the Westminster City Council success in their public-spirited quest; and inasmuch as there is nothing whatever to be gained by greediness, we should sincerely rejoice if the London County Council could report any substantial advance in the construction of smokeless kitcheners other than those which are gas-fired. The use of broken coke for kitchen ranges has been highly recommended; but it is not every pattern of close range that will cook efficiently with coke. Besides, it has to be recognized that few town dwellings are provided with adequate cellar accommodation even for coals, to say nothing of any place for coke. The number of coal kitcheners in the market is great; and they are nearly all equally wasteful of fuel, and more apt to heat the kitchen and the cook than their own ovens and hot-plates. As in England, at any rate, these fixtures belong to the landlord, the unhappy tenant who happens to get a bad one has no remedy except doing as much cooking as possible by gas.

The Standard Oil Company in Europe.

Referring to recent observations in these columns on the future of the petroleum supplies of the world, it is interesting to note that, as recorded elsewhere, a report has just been put in circulation to the effect that the Standard Oil Company have decided to purchase and exploit Roumanian oil-fields. What effect this proceeding, assuming the report to be true, may have upon the European and Caucasian oil trade is matter for conjecture. Hitherto, it has not been considered necessary by the great American monopolist concern to acually embark upon oil production in the East of Europe, because it has always been open to them or anybody else to buy the oil itself, free from all territorial embarrassments. It is quite possible, however, that the present operation may be designed to give the Standard Oil Company a footing in Europe from which other developments will proceed. Meanwhile, it may be observed that the market for oil shares is distinctly strengthening. Recent reports make it clear that there is a revival of interest in this class of property, which has been left severely alone of late years. This looks as if, in the judgment of well-informed people, the worst

had passed in regard to the condition of the Russian oil companies. It has already been remarked that the increased prices asked for fuel oil have killed the liquid fuel enterprise, of which so much was expected. A little more of the same movement will stop the British manufacture of carburetted water gas in all cases where there is no long contract running at workable prices. It has always been remarked of the price of oil, that the market fluctuations are much more serious than anything that happens in regard to gas coal, with rare exceptions. Thus, what has occurred lately with respect to oil quotations is tantamount to an increase of 30 to 40 per cent. on the old contracts. It is unnecessary to point out what a very serious disability this difference lays upon some gas undertakings. It can scarcely be believed that the true meaning of this state of things will be misunderstood by those in the trade. Gas oil is emphatically one of those commodities which will always sell at a price; but not at any price. It is one of the things which the world of industry, in England at any rate, could do without, if need arose, but of which a considerable and increasing use will always be made if a plentiful and regular supply is forthcoming at a reasonable figure.

The Final Report of the Arsenical Poisoning Commission.

THE final report of the Royal Commission on Arsenical Poisoning from the consumption of food and drink has just been published; and though it does not contain very much fresh matter, its appearance must not be permitted to pass without some comment and a few reflections. What a to-do there has been, to be sure, about this affair of the epidemic of arsenical poisoning in certain parts of England in 1900! All the over-indulgence in eating and beer-drinking which kills thousands of the population every year passed unregarded, until such time as an infinitesimal proportion of arsenic accidentally got into a particular make of brewing sugar, and about 70 people died and some thousands were made more or less ill by imbibing it. The case was sufficiently serious to call for adequate treatment of a remedial and preventive nature; and this was duly forthcoming. The incidental and consequential effects of the "scare," however, were extensive and peculiar. The birth-rate in the affected regions fell considerably; and medical science was temporarily bereft of at least one of those special diseases which are the glory of modern diagnosis. Among other discoveries made in this connection was that of the liability of malt to take up arsenic from the gas coke burnt in the kilns. Consequently, the use of this fuel for the purpose was discontinued everywhere, and other markets had to be found for it. There was another outbreak of arsenical beer poisoning in Halifax in 1902, which was traced to the use of a particular malt dried over gas coke. It is a very remarkable business altogether. The severity of the epidemic appears to have been connected with the minuteness of the doses in most of the cases—people accustomed to live by arsenic, so to speak, in the sense of roasting the ores of the West of England, being free from the evil effects that visited the copious beer drinkers of Manchester and Liverpool.

The Commissioners concluded, in reviewing the evidence, that the exclusion of small quantities of arsenic from food and drink is of infinitely greater importance than might at first sight be supposed, and calls for more attention than it has hitherto received. The analysis of fuels for arsenic is mentioned in the report. Incidentally, the comparative freedom from arsenic of sulphuric acid produced from the recovered sulphur of spent oxide is recorded. Some coal tar colours contain arsenic, probably derived from the sulphuric acid used in their preparation. It is suggested that liming coke will effectually arrest any arsenic it may contain, and keep it in the ashes. Happily, it is observed that "no "appreciable contamination seems likely to occur in the case "of food grilled over an open fire."

District Gas Associations and Affiliation.

The members of the Institution of Gas Engineers will have seen, with much gratification, in the report of the proceedings at the meeting of the Manchester Institution last week, that the Council of the larger organization have been giving full consideration to the suggestion made by the Past-President (Mr. A. Dougall), last June, as to the desirability of the affiliation of the District Associations. His remarks on the point were at the time well received by the members. As a result of the consideration by the Council, an official communication has been made by them to the various District Associations; and from this it will have been gathered that, while the Council do not in any way wish to interfere in the management of the District Associations, they desire that all the Associations shall be identified, by representation on the Council, with the management of the Institution. There is much to be said in favour of this, as, in the first place, it will give to each Association a voice in the direction of the affairs of the Institution, and so ensure the adequate representation of all parts of the country. In view of the fact that the Institution are proposing to break out into new work, and take upon themselves fresh and legitimate responsibilities, on the lines of the Presidential Address of last June, it is very desirable that the gas profession throughout the country should have an opportunity of sending to the central body men who have an acquaintance with their local needs to assist in the work of moulding, establishing, and subsequently directing any such new schemes. The proposed affiliation seems to offer a simple way of gaining this end. In the case of the Manchester Institution, the Committee have been instructed to consider the matter, and report to, and obtain the sanction of, the members before taking any definite action.

The Prospects of Agreement.

That the District Associations will eventually agree to the proposal, we have no doubt. The subject is not by any means a new one. Years ago it was broached, and has since Mr. Dougall re-opened it in June been frequently alluded to—having been a point in more than one presidential address. From these references, a little forecast can be made as to the probable attitude of the organizations, as a President in such matters of policy as a rule reflects the general opinion of his Committee. In his address in September to the Eastern Counties Association, Mr. J. H. Troughton discussed the question from the standpoint of how it would affect those of the members who were not members of the Institution. The Association covers a very large area, and contains many representatives from small towns, who it is rather doubtful, in Mr. Troughton's opinion, will ever become members of the Institution. But this is a "strong reason," in his view, for affiliation. To an extent, the Council of the Institution show their desire to legislate, through affiliation, for such members by admitting them "without payment of the usual entrance fee." Then Mr. Frank P. Tarratt, the President of the North of England Association, announced in his Inaugural Address how thoroughly he concurred in Mr. Dougall's hope that the earliest opportunity would be taken of affiliating the District Associations with the National Institution; and he trusted the efforts of the Council in this direction would be rewarded with success. Mr. H. Townsend will be the President of the Manchester Institution in the coming year; and his observations at the inaugural dinner of the Yorkshire Junior Association indicate that the subject has his sympathy, ev n to the point of bringing the junior organizations within the scheme. Mr. T. Lighbody, in his Inaugural Address to the North British Association, last July, did not touch specially upon the subject; but he is keen on taking steps for expanding the usefulness of the Association in the interests both of the members and the industry. Affiliation, too, would bring the Irish Association into closer touch with their English brethren. The Midland Association have a good "guide, philosopher, and friend" in such matters as this in their President (Mr. Charles Meiklejohn), who is a member of the Council of the Institution. And last, but not least, there is the Southern Association, whose Honorary Secretary (Mr. J. W. Helps) occupies the similar position in the Institution. From this survey of the personal influence (apart from the general beneficial aspects of the question) that will operate in the discussion and decision of this matter, it may be said that the prospects of affiliation are of the brightest.

Initial Burden of London Electric Lamps.

The course of the recent municipal election campaign in Islington did not run so smoothly as the Electric Lighting Committee would have liked, inasmuch as certain of the candidates said some perturbing things about the rates having been heavily charged to meet deficiencies in the accounts of the department. There seems to have been a little misunderstanding over the

matter; but there are yet points, it appears to us, that require clearing up before there can be any absolute certainty that the shuffling of the financial cards has not been beneficial to the department and detrimental to the ratepayers in a way that was not originally contemplated. There were a number of questions put to the Borough Treasurer on the subject a few days since, and that gentleman was in a position to give categorical answers to them all. He asserted that the electricity undertaking had never been subsidized from the rates; but there had been the transfer of a loan debt of £12,285 from the electricity undertaking to the general rate. It came about in this way: In the early days of the undertaking, the street arc lamps and columns were regarded as part, and were treated as assets, of the undertaking. The London County Council sanctioned the borrowing of £13,054 for the purpose; but they afterwards decided that the lamps and columns did not constitute part of the undertaking, but should be provided by the Vestry as the Local Authority under the Metropolis Management Acts. In consequence of this decision, the liability was transferred to the general rate from the accounts of the department—that is to say, the balance of the outstanding loan of £12,285—together with the asset represented by the lamps and columns, amounting to £14,980.

Who Benefits?

This brings us to the point where further explanation is needed just to elucidate whether the electric lighting undertaking is not gaining everything by the change at the expense of the general ratepayers. Since the transfer of the loan and asset, the interest and sinking fund have been paid out of the general rates, but prior to this, they were paid out of the revenues of the electricity undertaking. The general rate has repaid to the latter the amount of the sinking fund—£768 17s. 6d.; but there is still owing to the undertaking £1656, which represents the interest paid on the loans up to the time of the transfer. This debt by the ratepayers has yet to be discharged; and there is joy in the department over the fact that, when paid, it will just about wipe off the existing deficit of the undertaking, amounting to £1496 3s. 7d. It seems, however, a fair thing to ask whether this has not already been paid to the department in the sum handed over to them for public lighting service. We are not for a moment going to argue that the charge is not a proper one; but, from the ratepayers' point of view, it should be looked into a little deeper. It may be supposed that the amount that has been paid to the department for the service was originally placed at a sufficient figure to carry the charges in respect of the lamp loan; and, if this be so, it follows that the amount which should now be paid for the service should be reduced commensurately with those charges. Otherwise—assuming no reduction has been made—the ratepayers will, in a sense, be paying the charges twice over, to the advantage, in respect of one payment, of the department and the private electricity consumers. If the case is in accordance with the suggestion, the ratepayers had better see to it at once that the kind parental act of the London County Council is made to operate fairly between them and the department. At the same time, they might do worse than study the relative costs of gas and electric lamps—initial and annual—as set out in the table prepared by Mr. J. W. Bradley, the City Engineer of Westminster.

The Gaslight and Coke Company and Christmas Presents.

"By order of the Court" of the Gaslight and Coke Company, the following seasonable notice has been sent to contractors, tradesmen, and others:—

> The Directors of the Gaslight and Coke Company particularly request that no gratuity, present, or entertainment of whatever description, be offered to officers or other employees of the Company. Any contractor or other person disregarding this request will render himself liable to have his name removed from the Company's books.

It may be remembered that, in the "JOURNAL" for Sept. 22 last, a paragraph appeared headed "A Suggestion for Gas Directors and Committees," and calling attention to a report that had reached us that "an important company" were contemplating sending out before Christmas a circular of this kind. The "important company" and the Gaslight and Coke Company are one. We have no doubt that the Directors have very good reasons for taking the step they have done; and it must have been a cause of some regret to them that the necessity for the step should have arisen. The matter, it is evident from the length of time since we first heard of it, has had very serious consideration by the Court; and therefore it may be taken that the words "Any contractor or other person disregarding this request will render himself liable to have his name removed from the Company's books" are not by any means idle ones. It is to be hoped that contractors will see that, in their own interests and in those of the former recipients of presents direct or indirect, the best course to pursue will be to faithfully comply with the Directors' request. If any firms now try to do the same thing by a roundabout process, they will only meet with their deserts by being discovered, and an example made of them, for the benefit not only of the Gaslight Company but of the gas industry generally.

The Triumphs of Incandescent Gas.

We are pleased to be able to chronicle to-day another victory achieved by incandescent gas lighting over its opponent electricity. These triumphs have become now an almost everyday occurrence; but the present instance is a somewhat notable one, referring as it does to the lighting of no less a building than Canterbury Cathedral. The authorities had, it is stated, seriously considered the advisability of adopting electricity; but the highly satisfactory manner in which a portion of the sacred edifice was lighted by means of incandescent gas on the occasion of a recent oratorio, has induced them to change their minds and determine upon a complete installation of the latter system. This should prove a still further argument in favour of incandescent gas for church lighting in other places; and thus the Canterbury Gas and Water Company may, by their pushing policy, assist the industry at large as well as themselves. They are already experiencing the benefit of the advertisement, in a rush upon incandescent gas lighting. It may be mentioned, too, that this is not the only success in the same direction which the Company have achieved; for, apart from the Cathedral, four other churches in the city have recently been lighted throughout by incandescent gas.

The Millennium Light and Electric Arc Lamps.

In this country, very little has been heard of the Millennium light since Professor Lewes called attention to it in one of his Cantor Lectures twelve months since. But in the meantime it has been making splendid progress on the Continent; and we shall hear more of it in England very shortly. The light is brought to notice again, in a very striking manner, by a paper and diagrams recording some careful photometrical observations made by Professor Drehschmidt. Both are published in this issue; the diagrams, for convenience, being given as a plate. These observations show that the Millennium light scores a distinct success in comparison with electric arc lamps. Though they may err in doing so, the public are prone, in judging of public lighting, to pay too great a regard to the brilliancy of the sources of light, rather than to their effect as illuminating agents. Professor Drehschmidt has been at this work for years; and, recognizing this popular fancy, his experiments have been directed to creating light sources, by means of incandescent gas, as powerful as those obtained with the electric arc light. The Millennium apparatus came to his aid; and by it he was able to get from a single incandescent gas-burner (to employ his own words) "the so far unattained height of 1500 and 1800 Hefner candles." To put his photometrical results generally as gathered from the paper and diagrams, the high-pressure light obtained by this system easily beat the electric arc light at all points, excepting one; and there there was very little difference. This exception was on the horizontal surfaces in the centre of the roadways in the neighbourhood of the lamps; but—and this is more important—midway between the lamps on the roadway, on the side-walls, and on vertical surfaces, the gas-lights were far superior to the electric arcs. For further details as to the results, reference must be made to the paper and diagrams.

Testing Street-Lamps.

We have said that Professor Drehschmidt's tests were carefully made; and in his paper are found confirmation in the hints he gives as to the conditions affecting the testing of street-lamps. We have lamented the absence in previous published results of all

indication as to the time, and local and elemental circumstances, to assist in assessing the value of the tests. Professor Drehschmidt made his tests after midnight, in order to escape the influences of the brilliant lighting of shops and other business establishments, which so strongly affect the opinions of laymen; and this reminds us that it is generally in the streets containing the best lighted establishments that electric arc lamps are to be found doing street lighting duty. Other contributory circumstances of which laymen take no account, are the surroundings—as to whether the streets are bounded by houses or trees, or are open places, without reflecting surfaces. Taking these things into account, Professor Drehschmidt went about his photometric survey in a scientific manner. He did not stop at the degree of light on horizontal surfaces, but carried his observations to vertical surfaces. This is highly important, as the vertical surface "is the criterion for the clearness and distinctness with which persons and objects approaching towards the observer may be recognized." It will be seen, too, that the average of the degrees of light from the lamps observed in both directions was adopted as the standard. The notes upon these tests are both instructive and useful; and they should assist in producing greater accuracy in the making of street-lighting observations.

An Urban Council's Electricity Works for Sale.

Like many other similar bodies, the Urban District Council of Watford are the owners of an electric light undertaking; and, also like that of many other councils, their experience of this highly speculative business has not been a happy one. The receipts for the year ending March 31 last were £5844, the expenditure £4887, and the instalments of principal and interest £2540—leaving a deficiency of £1580. The amount expended on the undertaking up to the present has been about £58,000; and a further £25,000 is now said to be needed. For several years the Council have been faced with a loss on the working; and at last they have decided to take heroic measures—that is to say, they have, by a majority, made up their minds to try and rid themselves of this unprofitable business. On the recommendation of the Electric Light Committee, it has been resolved to enter into negotiations with the North Metropolitan Electric Supply Company for the sale of the works; and though some of the members fought hard against the proposal, it seems to us that those who voted for it displayed sound common sense. They have, indeed, set an example which might profitably be followed in some other quarters—if the local authorities were lucky enough to find a purchaser at a figure which would represent anything else than a ruinous sacrifice. There is something rather amusing in the objection of one of the speakers at the meeting, that the sale of the concern would be an admission that a body "composed principally of the tradesmen of Watford were unequal to properly conduct a lighting undertaking." It might, or it might not. This gentleman stated that "when he was a young man he was warned of the deception arising from figures." What a pity it is that he and others did not succeed in impressing a similar need for caution upon the members of the Council when they were first of all considering the advisability of entering upon the electric light business! Instead of such a thing happening, it appears that only one member lifted up his voice in opposition to the scheme; and, to use his own words, "he was practically laughed off the Council for it." The event has, however, amply justified the attitude he adopted at the time; and there are many others who must agree with him that "the chief characteristic of the electric light is that it is always going to pay, but never does." It is our duty to draw attention to what has happened at Watford, though it seems almost too much to hope that any great heed will be paid to the lesson which it conveys. So many local authorities are possessed of the idea that "there are certain benefits accruing to the possession of these monopolies." Though precisely what these benefits are, it is, in practice, often very difficult to discover.

Cost of Councillors' Luncheons.

A certain section of the Liverpool City Council (having apparently been struck by the many references that have of late been made to what are considered the extravagant ideas of municipalities in general), have conceived the notion that some economy might be effected in reducing the outlay at present incurred in the provision of luncheons or dinners for those engaged on the ratepayers' affairs. The matter was introduced at last week's meeting of the Council, on the recommendation of the Finance Committee limiting the cost of such meals, on the occasion of Committee inspections, &c., to 6s. 6d. per head; and about a couple of hours were taken up in a fruitless—and at times exceedingly acrimonious—discussion. The mover of the adoption of the recommendation said he thought "it ought to meet the economical views of the Council," and pointed out that it did not apply to the luncheons given in the Town Hall on the occasion of Council meetings. An amendment was, however, promptly moved and seconded reducing the amount to 4s. 6d.; and then the fun began. One member stated that the mover of the amendment was not present at the last inspection of the Market Committee, but nevertheless turned up at the luncheon; and he added that the resolution of those gentlemen who had so much to say with reference to the luncheons "seemed to break down in face of the temptation provided by the smell of cooking going on in the Town Hall." After a considerable amount of what can only be designated as wrangling, the amendment was carried; but the matter did not by any means end here.

Sixpence per Head Suggested.

A further amendment was immediately moved to reduce the amount to 6d. per head—"which would mean that they would have no luncheons at all." The seconder of this generous proposition said he was in favour of sixpenny luncheons because medical men and economists in diet were providing meals at this price for the benefit of the human race. He stated that "immediately after lunch he noticed there was a dead-level of mediocrity of intelligence among members of the Council;" and subsequent remarks showed that he was advocating the introduction of vegetarianism. Without venturing on an opinion as to the respective merits of roast beef and lentils as an aid to intelligence, we confess to a considerable amount of sympathy with the member who objected to sit still and be insulted in that way. In the end, the amendment was carried; but when put as the substantive motion, it was hopelessly lost. The result, therefore, of all this talk is to leave things as they were. Each Committee will adopt its own course, and take the risk of having its proceedings confirmed by the Council. Such a debate as the one under notice does not—to put it mildly—add to the dignity of the Council; and the advocates of economy (if this was their real object, and not self-advertisement) can only do harm to their cause by such tactics as were here indulged in. In any event, it is impossible to believe that they can have been voicing the opinions of the majority of the ratepayers.

The Law as to the Lowest Tender.

A "Legal Contributor" to the "Engineer" has written to point out that, even when the invitation to tender contains no statement on the subject, there is no implied obligation to accept the lowest or any tender. The custom of a trade may be different, which requires to be shown. A tender may be withdrawn at any time before it is accepted; but it remains open until the other party receives actual notice of retractation. When a tender is accepted, an enforceable contract is made; and the law holds that posting the acceptance is sufficient. A tender and acceptance may amount to a contract, though the latter mentions a formal contract to be afterwards drawn up and signed. Where, however, those who advertise for tenders state that the signing of a written contract is an essential part of the advertisement, there is no contract until this condition is fulfilled. The foregoing statement—that acceptance concludes the contract—does not apply to companies, unless the writing is under seal. An agreement of parties not to tender competitively not only holds good in law, but may go beyond a contract in immediate contemplation. Thus two dealers agreed not to tender in competition for gas tar. In pursuance of this, one sent in a nominal tender, and the other a real one which was accepted. Subsequently, upon the issue of a fresh advertisement, the second party tendered again without having communicated with the first. It was decided that he was liable in an action for damages for breach of contract.

Oil for Gas-Making.—In regard to a paragraph under this heading last week (and which was sent with a request for publication), we are asked to state that the second of the two Companies referred to—the Consolidated Petroleum Company—is not importing Roumanian solar oil.

WATER AFFAIRS.

The Metropolitan Water-Works Arbitration.

WHAT may not inappropriately be called the second stage in the arbitration proceedings under the Metropolis Water Act, 1902, was reached last Thursday, when the case of the New River Company was brought to a temporary close, and the third stage—the consideration of the claim of the Grand Junction Company—was entered upon. We say "temporary," because there are some important questions to be settled by the Law Courts before an award can be made. There are no less than nine points on which the first-named Company may desire to appeal; the most significant one being the decision limiting their dividend to 10 per cent., and thereby reducing their claim by about £5,000,000 "at one fell swoop." The final pronouncement upon this matter will depend largely upon the result of the appeal of the Kent Water Company against the decision given by the High Court early this year, and upheld in the Court above, in the Lamplough case, which is expected to come before the House of Lords next week. The other points, which have been incidentally noticed as they have arisen, cannot be disposed of for some time; and therefore they have been left, and the less contentious matters proceeded with. The position when the inquiry was resumed on Monday morning was that the Company's case had been closed, and Mr. Fletcher Moulton, K.C., had commenced his address to the Arbitrators in support of the Water Board's answer to it. The learned Counsel did not, however, proceed with it immediately, owing to the intervention of Mr. Balfour Browne, who put in the corrected accounts of the Company for the past ten years, with the view of showing that the increase in the water-rental had been exactly 1·97 per cent. per annum—the estimated future increase on which the claim had been based.

The subject of the condition of the Staines works was then again brought forward; Sir Benjamin Baker being called on behalf of the Water Board, and Mr. James Mansergh, Mr. Charles Hawksley, Mr. E. M. Eaton, and Mr. Theo. Foxley for the Company. Sir Benjamin spoke rather disparagingly of the construction of the aqueduct, a portion of which he had inspected; but, with all deference to the talented Engineer of the Forth Bridge and the Nile Dam, we attach more weight, in this matter, to the evidence of the specialists in water works construction who followed him than to his. Mr. Mansergh, who, as the Engineer of the Birmingham water scheme, must be regarded as an authority on this subject, said he considered the works, as a whole had been well designed and excellently carried out. However, in view of the difference of opinion among the witnesses as to the stability of the works, it has been arranged that they should be visited by Sir John Wolfe-Barry, accompanied by an Engineer representing each side. This matter disposed of, the President delivered the judgment of the Court on the deferred question of the profits resulting from the Company's lands in Clerkenwell; the point for decision being whether they were profits of the undertaking within the terms of the Water-Works Clauses Act, 1847, the provisions of which had, with certain exceptions, been incorporated in the Company's Act of 1852. As from that year down to 1871 these profits had been treated by the Company as profits of the undertaking, the Arbitrators held that they had been properly so regarded. This, as will be seen from the case stated by the President on Saturday last, which will be found in another column, is one of the matters that will be submitted to the Appeal Court.

Mr. Moulton then proceeded with his address. It may be remembered that the amended tables put in by the Company showed a sum of £7,345,309 as the capitalized value of the maximum dividends of £201,996 in perpetuity; and the learned Counsel contended that, assuming the Company, showed a maintainable income of this amount, they should be paid the capitalized value of the sum *minus* the value of the Clerkenwell Estate. If the undertaking would bring in so much less than 10 per cent. that the estate would not make the profit exceed this rate, it would be sufficient if the portion the Board were going to take away were valued. But if, on the other hand, the undertaking *plus* the value of the estate came to more than 10 per cent., then the maximum value of the whole concern was the capitalized value of the 10 per cent. The course to be pursued in regard to this matter was left for Counsel to settle between themselves. Evidence was then given on behalf of the Board; the first witness to be called being Mr. H. E. Haward, the Comptroller of the London County Council. He put in a number of tables to show that the Company would not be able to earn 10 per cent. if they continued to exist. He estimated that the water-rental in 1903 would be £611,714, and that it would increase by £9500 annually—reaching £687,714 in 1911. The available balance on the former amount would be £222,559; on the latter, £169,052. The interest would thus fall from 11·01 to 8·37 per cent. Mr. W. Plender, the Board's Accountant, followed with further statistical evidence, in the course of which he stated that the Company had paid between 1852 and 1892 something like £1,267,333 as dividend on share capital in excess of 10 per cent. Attention was again turned to engineering matters; and Sir Alexander Binnie was called, and condemned the Company's storage and filtration plant as inadequate. This brought the proceedings to the mid-week adjournment.

On Thursday, the attack of the representatives of the Water Board was directed against the quality of the Company's supply; and Dr. Klein gave evidence in support of it. He stated the results of his bacteriological examination of 24 samples of water taken after storage and before filtration, after filtration, and from the taps. Some 30 per cent. of the samples were found to contain intestinal organisms in about 0·6 of a cubic inch of water, or less. The President (Sir Edward Fry) suggested to the witness that all these organisms were not necessarily injurious to health; but he hesitated to give a direct answer to the question—merely remarking that it would be a very difficult operation to separate the dangerous from the harmless microbes. Further engineering evidence having been called to support the contention that the Company's filtration area was insufficient, the case for the Water Board was brought to a close, and that of the Grand Junction Company opened. Their claim amounts to £4,863,195; the principal item being a sum of £4,260,000, the maximum dividend of £117,150, at 36·36 years' purchase. The proceedings in this case will be noticed next week.

Before leaving the subject of the arbitration, attention must be called to an act of indiscretion on the part of the Bermondsey Borough Council, the Town Clerk of which body forwarded to the President, on Thursday afternoon, a letter containing a copy of a report of their Medical Officer of Health to the Public Health Committee, on the subject of the "impure condition" of the water supplied by the Southwark and Vauxhall and Lambeth Companies. This proceeding was indignantly protested against by Sir Edward Fry, who characterized the communication as a "highly "improper" one; and he peremptorily ordered it to be sent back to the parties from whom it had come. No good purpose will be served by such tactics as these; and it is therefore gratifying to find Mr. Fletcher Moulton was able to assure the Arbitrators that the Water Board did not know anything about the matter. When the cases of these Companies come up for consideration, the advisers of the Board will be quite equal to the production of damaging evidence without any prompting from Bermondsey; and certainly the members of the tribunal to which it will be submitted possess sufficient judicial acumen to appraise its relevancy and value without any assistance from that quarter.

Informing the Gas Consumer.—Some time ago, we had, in a "Communicated Article," the experiences of Mr. F. W. Cross on the question of the special means he had then taken for pushing the gas business in the district of the Lea Bridge Gas Company, with excellent, encouraging effect. He has now produced a series of dialogues for distribution among the consumers, dealing with matters of general and particular interest to them; their object being an educative one. The dialogues are written in a chatty and readable style; and they are bound to have some good result in teaching the consumers more than many of them have hitherto known about the distribution and proper and economical use of gas. The first dialogue has for its subject "Bad Gas and General Complaints;" the second is "A Talk about the Pressure of Gas;" the third is "A Chat with the Gas-Meter Inspector;" the fourth is "On the Selection of a Gas-Cooker;" and the fifth is on "Shop Window Lighting." Mr. Cross has also distributed a circular giving a few notes on the relative cost of incandescent gas and electric lighting. He has a strong belief in the power of a plain statement of printed facts in carrying conviction. Being in print, the consumer has them before him for full consideration. The series of dialogues are good, and should be helpful to the Company.

ESSAYS AND REVIEWS.

PROSPEROUS TOTTENHAM AND A LARGE MODERNIZING SCHEME.

(*Concluded from p.* 529.)

In this account of the comprehensive scheme of re-arrangement and enlargement at the works of the Tottenham and Edmonton Gas Company, it will have been remarked that we are not proceeding on the systematic line, but are telling the story of what has been done, and is in prospect, in the order of situation of the plant as found in a walk round the works, commencing, as seen last week, in the retort-house.

On leaving the boiler-house, the condensers next come under observation. These are of the ordinary horizontal air-cooled type; and it is noticed that they are built in sections, so that any number of sections can be put to work or shut off, as the case may be, to regulate to a fairly uniform point the temperature of the gas as it passes from them. The condensers are fitted with a reversible arrangement, so that the direction of the flow of gas can be alternated week by week. This large group of condensers are to quit their old accustomed spot next year, and to be re-erected in the new portion of the works. This system of condensers lends itself well to any amount of extension by merely adding more sections; and some new sections will be erected next year on the new site previous to the old ones being transferred to it from their present position. The reason Tottenham adheres to air-cooled condensers, Mr. Broadberry explains, is that they are found to work absolutely without trouble and expense. This is an important matter to the Company when they are short of water, and have to buy all they require from the New River Company, at the rate of 1s. per 1000 gallons.

Adjacent is found the sulphate of ammonia house; and the first thing that the eye alights on is the Galloway boiler to which allusion has been made as having been removed from the boiler-house. But the sulphate of ammonia plant claims attention. The 20-ton Simon ammonia still, which was formerly housed here, became too small for the Company's requirements; and last year, they had to put in a new 50-ton still. This is of the type made by the Berlin-Anhaltische Maschinenbau Actien Gesellschaft; and the combined plant is capable of producing 4½ tons of sulphate a day. There were reasons for the adoption of the German plant. One is that it does not take up nearly so much room as the old 20-ton still; and Mr. Broadberry states that it does its work very efficiently. There is a further consideration. One novel feature in connection with the still is that the liquor is heated by means of the waste liquor instead of by the waste gases. This tends to cool the spent liquor, which is rather an advantage at Tottenham at the present time. The Company have lately received notice from the Lea Conservancy, the East London Water-Works Company, and the Middlesex County Council that they are no longer to be allowed to run their effluent into the Lea; and, this being so, they have had to make arrangements with the Edmonton Urban District Council to take the effluent into their sewers. This the Council were quite willing to do, so long as it is cooled down to a moderate temperature. The change has also necessitated the running of a sewer through the works yard for a distance of about 400 yards.

This ends the range of buildings on the outer side of the roadway which ran along the southern side of the works down to the railway sidings. On the opposite side, the clearance process has already begun; and as soon as two or three small houses—too small for to-day's needs—are demolished, this will open up a fine expanse of central yard space for railway and other traffic, and will be an inestimable boon in ordering the works operations. The old water-gas meter-house has already disappeared, as, in straightening out the works system and connections, the meter had to be removed to a new site. Next to this now vacant space stands the old governor-house, through which we have to pass in single file. It contains three 18-inch Cowan governors, with bye-passes. These governors were erected some 27 or 28 years ago; and the output of gas now is about eight times what it was then. They have done excellent service, but are now too small. Near by the yard entrance, the work of installing their successors is already proceeding. There is a short range of buildings there which were formerly adequate for the works offices, but they got too small, and were finally discarded for that purpose on the offices outside in Willoughby Lane becoming available for the engineering staff, on the removal of the Secretary's (Mr. James Randall's) department to the palatial edifice which the Company have put up in the High Road, Tottenham, so as to be centrally situated and the Company represented for commercial purposes and distribution work in the recognized business quarter of the district. However, the old works offices have had the interior walls and floors taken out, and converted to the purposes of a governor-house, for which the building is admirably adapted. It has been arranged to accommodate two 30-inch governors, one 24-inch, and one 18-inch, with bye-passes. These governors have, with the exception of a 30-inch one (which is to be provided for future extensions), been established in position, and were, at the time of the visit, being connected to their respective mains. The governors are all of the Cowan make. With the finish of this work, the old governor-house will be effaced; and then the large clear space which will meet the view on entering the works will have been completely gained. Perhaps it may not be out of place to mention here that the initial pressure at the works is 15 inches on the high-pressure mains; and the gas is delivered from various points in the large district at 5 inches pressure.

As will have been seen, each step in the scheme has made it opportune for executing other work that Time's changes and growth upon growth have made necessary. Last year a new gasholder of 3,100,000 cubic feet capacity (making the total storage on the works, including the relief holder, about 6,000,000 cubic feet), was completed by Messrs. Samuel Cutler and Sons; and the connecting up of this, together with the institution of the larger governors, supplied a convenient occasion for reconstructing the whole of the works connections. The gasholder valves were therefore assembled into one house (to be referred to more particularly presently), instead of being disposed here and there along the line of the gasholder embankment; and a 36-inch outlet main was run from the gasholder-valve house—a distance of 150 yards—to the new governor-house. The removal of the old gasholder valves, too, gave the opportunity for widening the entrance to the works, which was very much constricted, as well as of straightening out and improving the railways about the works, on which there were previously some most awkward curves to be negotiated.

A piece of ground, adjoining the governor-house, the shape of which it would be difficult to properly define, has been covered with a substantial and spacious building, which will form the new workshops. Provision is here made for carpenters, blacksmiths, and machinery shops, which are to be fitted up on the most approved principles, and some first-class machine tools will hereafter be found there. An exhaust-fan is also to be installed, to draw away the smoke and fliers from the forges, and to keep the air of the workshops perfectly sweet and pure. The shops will be light and airy; and the men will find them very comfortable working quarters. At one end, the railway runs direct into the shops. As a point of interest, it may be appropriately mentioned here that, at the High Road offices, shops are being erected for the special purposes of renovating the gas-cookers which are returned from hire. Arrangements are also being made there for thoroughly testing the stoves before being sent out, in order to adjust the gas and air supply of all burners, so that they shall give the best efficiency.

The removal of the water-gas meter has already been noted; and the next building into which we step contains it. It is a nice house, built up to the higher standard of decorative finish to which reference was made in the course of last week's article, and which is found to add but insignificantly to the cost. It is light in style; and the walls are painted in a tinted colour, with a fancy dado. Provision has been made in the house for a larger meter when required. Passing onward, attention is directed to the new well-arranged buildings, in which are the urinals, lavatories, and shower-baths for the men. The interior walls of the building are of glazed brick; and everything is found to have been done to maintain a good state of sanitation, and to encourage the men in healthful and cleanly habits. The new laboratory and foreman's offices are noted; and this brought us to a large carburine tank, which has been removed from its old site to one near the gasholder-valve house, which house is to contain the Maxim-Clark carburettor for use in enriching the coal gas at any time there may be occasion to temporarily discontinue the manufacture of carburetted water gas. The Tottenham Company are not likely to seek parliamentary sanction to a reduction of their standard illuminating power, which is 15 candles; and therefore the Engineer likes to keep a spare string for his bow.

Close at hand, is seen another piece of work in progress—that is the re-erection and enlargement of the oil-tanks, which, it may be incidentally remarked, are fed by pipe-line from the River Lea—a distance of about ¾ mile. The site upon which they are being located is a corner of the works which would not be valuable for any other purpose. There are two of these tanks being shifted, and a new one constructed. The old ones are also being deepened by two rings of plates, which will extend them from 12 to 20 feet deep. Their diameter is 35 feet; and when the three tanks are finished, they will supply oil storage accommodation for 1200 tons. In re-erecting the two old tanks on their new site, a change in construction is also being made. The tanks have hitherto stood in circular concrete pits of much larger diameter than the tanks, so that the walls of the pits and the shell of the tank formed an annular space, which space was calculated to be sufficient to contain all the oil standing in the tank above ground-level, in the event of an escape of the oil through injury to the tanks. Experience has shown this to be an unnecessary precaution, which was harmful to the tanks themselves, as with every shower of rain, water collected in the *annulus*, and produced corrosion at the base of the tank. Therefore, in re-erecting them, the tanks are being built above ground-line, so as to be kept clear of almost constant contact with moisture as hitherto. One of the two tanks has already been removed. It was simply elevated by means of a derrick from its old seat in the concrete tank, turned on to its side, and the awkward, ponderous structure rolled to its new situation. This was done by the Company's own men; and then the work of extension and erection was taken in hand by

Messrs. C. & W. Walker, Limited, who have also the contract for the new oil-tank.

This brings us to the gasholder valve house, which, both outside and inside, forms quite a pleasing feature of the works, apart from its equipment. It is seen that a very little nimbleness in idea and design will give very agreeable pieces of relief here and there among the heavier plant; and this house is an instance. It is about 50 feet long by 25 feet wide inside, and it has a semi-circular and lantern roof, of the style frequently adopted for billiard rooms and public swimming baths; and, in addition, the house is plentifully supplied with elliptical arched windows on all sides. Inside, the curved rafters of the domed part of the roof, and the panelled flat top, with gilt edgings, look extremely well. The platform running down the centre (about 6 feet above the ground-level), and completely filling one end of the house from side to side—thus forming a platform of T shape—is composed of Terrazzo paving, which is a kind of imitation mosaic, and supplies a good-looking, durable floor. Round the platform is a mahogany handrail. A couple of brass pendants with a pair of inverted burners on each supplies light at night time. Under the platform are the 36-inch inlet and outlet pipes for the gasholders; and the arrangement permits the convenience of the inlet and outlet pipes of each holder being placed side by side. These huge pipes will be painted and kept as near pure white as may be—not only for cleanliness and appearance, but also in order to get as much reflected light as possible underneath the platform. There is, of course, a bye-pass from the inlet to the outlet of the holders; and on the platform is one of Cowan's safety governors, which opens automatically in the event of the accidental closing of the outlet-valves. On the platform are also the valve standards, and, opposite the Cowan governor, a steam turbine driving a Sturtevant gas-exhauster. This was originally used for removing the gas from the light holders into the heavier ones for the purpose of giving a substantial pressure for night distribution. The rapid development of the neighbourhood, however, has made it necessary for Mr. Broadberry to turn some of his leading mains into high-pressure ones; and this is the means at present employed for "boosting" the pressure. In one part of the old works' offices, which now form the new governor-house, there has been laid down a new plant specially for this purpose. In this case, the fan is of the Buffalo Forge Company's type, driven by a 23-horse power Crossley gas-engine. The Sturtevant fan in the gasholder-valve house, however, will, when the new plant has been brought into use, still be available as a stand-by. The platform in the valve-house will also afford space for the Maxim-Clark carburettor, which will act (when needed) directly on to the outlet-main of the gasholders. The carburine tank, as already stated, is being re-erected outside this house; and there is one further point about it to which attention may be directed. Every precaution will be taken, as before, to preserve the tank from variations in temperature, and the ventilation of the space above the liquid will still be provided by connecting up to it a gas-main to ensure the impossibility of the collection there of any explosive mixture. Thus no air will pass in for ventilation; it will always be gas.

From the gasholder-valve house, a visit was paid to the carburetted water-gas plant, which is such an important feature of the Tottenham works; it having been considerably extended from time to time. The original installation consisted of two sets of 375,000 cubic feet each per day. Since then, two 500,000 cubic feet and one 1 million cubic feet sets have been added. The plant is all of the Humphreys and Glasgow make. The coal-gas plant is equal to 2½ million cubic feet per day. It may be a point of interest to mention that, speaking roughly, about a half of the net output of coke is used for the production of water gas. The water-gas plant machinery room, as originally constructed, was sufficient for the first and second installations; but then it became necessary to build a new one for a further extension of the plant. This room is also finished in the better style that has become the fashion at Tottenham nowadays; and remembering the impression made by the comfortable, clean, and attractive setting to the large clean and bright machinery, almost gives a desire to dilate on the efficacy of a little additional expenditure on paint and tiles in producing cheerfulness and maintaining brightness about a place. Sure are we of this, that such surroundings animate the attendants to keep the machinery under their charge in a condition to match; for dirty machinery looks immeasurably worse amid such surroundings than it would appear to be in a plain, ugly building. However, the house contains two No. 10 and two No. 7 blowers—the latter being the older ones. These are used in the summer time; and the larger ones for the winter make. In connection with the water-gas plant, there has also been an installation of an extensive set of new tar-separators.

We have described the work done or in hand in this large scheme of modernization, and indicated other work to which these changes have given rise. But this does not complete the work which the fertility of the district in gas business renders compulsory. There is much to be done before the scheme as planned is rounded off, without taking into account the smaller changes that are from time to time needed on all large works. Summing up, however, in few lines what the future has in store in the way of extensions: The foundations are in for a new retort-house on the north side of the works; another carburetted water-gas plant of a million cubic feet capacity is in contemplation; next year a new building will have to be put up for additional scrubbing plant, the erection of which will be commenced before many more days have passed; the condensers have to be removed and added to; a new exhauster-house has to be built, with a large water-tank on top; and new tar and liquor tanks have to be constructed. Besides, there is no present prospect of any abatement in the average annual 10-mile (or thereabouts) additions to the distribution system.

In these articles, there has been no attempt to do anything more than given a superficial view of the considerable scheme of improvement and extension that the rapid growth in consumption has demanded, in the carrying out of the heavy work of which scheme Mr. Broadbery has, in the past eighteen months or so, found a capable and willing helper in his chief assistant, Mr. J. Terrace. The Company's history in latter years shows that they have been favoured beyond the lot of the majority of gas companies serving districts in which the process of development and land occupation are yet far away from completion; and the outlook, as seen in the first article, is full of promise. Upon this happy position all associated with the Company, from the Chairman downwards, are to be heartily congratulated.

THE PREPARATION OF ENGINEER'S STUDENTS.

We have already touched upon the subject of preparation for the full development of the possibilities of the industrial life, with reference to the needs of Labour and the responsibilities of Capital. Another of these short studies of a great question may be profitably devoted to the case of the engineering student, or apprentice. As regards such students of gas engineering as come within the purview of Dr. Harold G. Colman, the Examiner in this subject for the City and Guilds of London Institute, the latest report on their condition reads like a commentary on our criticisms. Not for the first time, the Examiner has to find fault with the preparation of the candidates for these examinations. There is too much cramming or "mugging up" the subject by the aid of old papers, and not enough real knowledge of the technic. At this rate, practical men will begin to ask again what is the good of these examinations, which apparently appeal much more to the "pupil teacher" class of certificate-seekers than to men who have their living to get in gas-works. But here again the question strikes back to an antecedent qualification, which has nothing to do with the so-called educational system. The system is useless, and worse than useless, if it results in mere examinationism, not in instruction calculated to produce fruit in due season. The sower here has struck some very "light soil."

Speaking the other day on a cognate topic, Sir William Allan said of technical instruction that, while it was undoubtedly of advantage to an apprentice student, "unless he possessed the following qualities he had poor chance of coming to the front or being truly efficient: First, capacity, grasp, intelligence; secondly, the power of learning to lead and guide men; thirdly, tact, receptivity, and perception. In a word, he must possess brains." This is to say a good deal. Of course, it is true; everybody knows it to be true. But what a commentary it forms on pure educationism! Sir William proceeded to sound the depths of the subject when he strongly advocated the encouragement by managers and foremen of lads with possibilities. "A little encouragement went a long way with a clever youth." Wise words, and worthy of being treasured up by all whom they may concern. The selection of promising youths is, indeed, one of the greatest responsibilities of seniors. Sir W. Allan claimed that at his Scotia Works, Sunderland, they had done very well by and for their apprentices, mainly by taking a real interest in the lads. "They took the lads under their care; they showed an interest in them; they encouraged them. They trained them from striking fore-hammer to the tool dresser, to every tool in the shop. . . . The policy was simply a special course of training in the factory, and they insisted on apprentices attending science classes in the evenings during the winter months." Sir W. Allan does not believe in splitting up a lad's apprenticeship time equally between shops and classes, on the ground that so much time given to theory is neither necessary nor expedient. Five years' practical training is not too much for any profession. Evidently, Sir W. Allan thinks that the age for reasoning on practical operations should come later.

Probably there is a good deal in this opinion. The practical way of looking at things is not to be acquired unless the actual doing of them has been instilled in the expanding mind—at first, perhaps, pretty much as matter of routine. Reasoning comes afterwards, if at all. That is how the rivet boy becomes a foreman, and the student apprentice an engineer. The men with little or no brains, or without any stability of character, remain among the rank and file. It is absurd to think that any amount of technical education could elevate them. But for the few who are endowed by Nature with brains and character, and with bodily health and strength to boot, there is no apparent limitation. Shower instruction upon them, and it will bear fruit beyond the deserts of any husbandry. They are the good soil, for which the best of seed only is appropriate. Any inferior seeding would be a waste of opportunity, just as the sowing of good seed in the wrong place is waste of everything. The true engineer is born,

not made; but he is capable of infinite improvement. Perhaps the best way of ascertaining how this process of development might be most successfully organized would be to get such engineers as Sir W. Allan, Sir Hiram Maxim, Sir W. Arrol, Sir George Livesey, together with others of the type of the Hon. Charles Parsons and Professor Ewing, to state, from their own experience, what they most lacked, and what proved most helpful to them, in their career. If the essentials could be sifted from the accidentals of such testimony, a sound curriculum should be left in the sieve.

MUNICIPAL FINANCE AND LOCAL GOVERNMENT AUDIT.

An inquiry of a remarkable character has just concluded at Plymouth. For ten days two Inspectors of the Local Government Board—Mr. E. P. Burd, representing the Accountancy Department, and Mr. H. P. Bulnois, the engineering side—were engaged in an investigation of the affairs of the borough, with a view to determine what, if any, assistance should be afforded the unfortunate ratepayers in their efforts to free themselves from the manifold entanglements into which they have been led by a Progressive municipal policy. Last session, the Corporation went up to Parliament with a Bill which would have enabled them to raise further money to satisfy their immediate needs; but, as Parliament refused to grant relief, except upon the condition that the accounts of the borough were subjected to periodical investigation by a Local Government Board Auditor, armed with the power of surcharge of illegal expenditure, the Bill was abandoned. The Corporation, however, want a quarter-of-a-million sterling, most of which they have spent in anticipation of formal sanction; and though they were very indignant a few months ago with the Board for impressing upon the Parliamentary Committees the need of an efficient check upon their spendthrift courses, they were driven in the end to return to the Board for assistance in their difficulties. The result has been an investigation almost without parallel in recent municipal history, coupled with revelations which must make very painful reading for the ratepayers.

Plymouth's modern municipal history dates back for but little more than a decade. It seems to have embarked on its Progressive policy no longer ago than the year 1892; since then it has pursued a regular Rake's Progress. In 1892, its total municipal debt was no more than £255,537; now it is £1,722,324. For a population of 112,000, this should be sufficient to satisfy the most ardent advocate of Municipal Socialism. Unfortunately for those who have to bear the burden of it, the end of this piling-up of debt is not yet in sight. The town is committed by its rulers to many schemes (some of which are in progress), the ultimate cost of which no one attempts to estimate. Of these the most formidable are main drainage works, the original estimate for which was £100,000. But they are not expected to be completed for much, if any, less than twice this sum; and they will leave the town the legacy of a costly lawsuit with one of the contractors. Whatever relief may come from the hoped-for extension of borrowing powers, the ratepayers' outlook for the future is thus one long melancholy vista of increasing demands upon his purse; and the rates, which have increased upon steadily growing assessments from 5s. 11d. to 7s. 2d. in the pound, are likely to go on until they reach the point at which the strain becomes absolutely unbearable. Already the effect of the want of prudence on the part of its rulers seems to have made itself painfully apparent in Plymouth. One of the facts elicited during the inquiry was that, although it is one of the most overcrowded towns in the country, and suffers in some parts from terrible conditions of congestion of population, there are nevertheless great numbers of houses to let, and there is such a slump in the building trade, that the Corporation are wholly unable to sell large tracts of land which they have on hand in connection with street improvement schemes which have been carried out. In this direction of overcrowding, as in others, the burden of the reckless expenditure of the Corporation bears most heavily upon the poorest of the population, as is only to be expected. One of the arguments frequently advanced in support of municipal trading is that the workers have a right to the profit of such ventures as gas and water undertakings carried on for the benefit of the community. It ought not to be overlooked that where no profit results, as is mainly the case in connection with the Plymouth municipal schemes, the workers have either directly or indirectly to make up the deficit.

It would serve no useful purpose to go through the long list of difficulties and irregularities revealed in the course of the protracted inquiry. A good deal was said about the Corporation's method of finance. Very large sums of money have been spent in anticipation of the expenditure being some day sanctioned by the Local Government Board. This has been done by getting an overdraft from the bank, which has been reduced from time to time as money has been raised on loan for the carrying out of works actually sanctioned. It was said in defence of the system that it prevented the actual stoppage of works, like the main drainage scheme, which were found to exceed the estimated cost. On the other hand, it was shown that in one instance at least the Corporation raised £20,000 to build a works depôt and stables which the Local Government Board sanctioned, but that, on changing their mind, they let all the money go into the bank in reduction of the overdraft, and did not put up any buildings. In numerous instances, money has been raised for carrying out schemes which have still to be completed, though the balance in hand only exists as a paper entry. Another system about which a good deal was said, both in Parliament and in the course of the inquiry, was that of forming illegal suspense accounts. Under this head came a payment to the Plymouth and Stonehouse Gas Company for the purchase of the lamp-posts in the borough, and a charge of £2776 for the purchase of lanterns, burners, &c., for incandescent lighting. When the Corporation decided to take over the public lighting, and establish the incandescent system, it was decided to pay the cost out of revenue, and spread it over a few years. This was done in other cases—mainly because the Corporation had reached the margin of their borrowing powers—until the suspense account became a considerable item; and a large portion of it now remains to be liquidated or transferred to a regular loan account.

One of the largest items for which sanction was asked was £41,465 for extensions of buildings, machinery, and mains in connection with the electricity works during this year; and an additional £6700 for electric lighting. In connection with these sums, it was elicited that most of the money has been already spent, and that the balance will only suffice to carry on until the end of the current year. The Electrical Engineer was cross-examined on the subject of depreciation; and attention was directed to recent reports in which it was stated that £30,000 would be required in the next few years for the reconstruction of the electric tramway system. It was admitted by the Engineer that a depreciation fund is necessary, and that there is none in existence. It was, however, explained by the Borough Treasurer that the profit of last year has wiped out the adverse balance, and that the accounts show a reserve fund of £409. Mr. Burd commented on the fact that this is not an actual reserve fund in cash, but a paper entry to balance the income and expenditure account. He also pointed out that the department is credited with £10,150—a balance unexpended under a previous sanction; and he said if the money had been allocated, as the Local Government Board said ought to have been done, when it was first borrowed, the accounts would have shown this £10,000 in hand of money actually borrowed. But instead of having anything in hand, Plymouth owes a big balance to its bankers; and even if it gets the relief it now seeks, it is not likely to escape without paying a severe penalty for its departure from the path of financial rectitude.

Few in Plymouth seem to be anxious for the appointment of a Local Government Board Auditor, which appears to be considered derogatory to the dignity and freedom of the borough. But it is abundantly clear that Plymouth must raise money; and if it cannot get it without taking the Government Auditor also, it must needs submit. A check upon the freedom of expenditure, even if it means a lessening of the dignity of the Town Council, could scarcely be a bad thing from the ratepayers' point of view.

ELECTRIC LIGHTING MEMORANDA.

The Electric Lighting Notices—Electric Power at Hackney—Mr. Parshall's "Bulk" Generating Stations—Where is the Big Gas-Engine?

It is reported that the year's crop of electric lighting notices for Provisional Orders shows only a slight falling off from the number for last session. Thirty-seven Local Authorities and 46 Companies are to apply for Electric Lighting Orders; and 14 Local Authorities and 12 Companies are going for combined Lighting and Power Bills. Most of the electricity supply concerns in the list will be small, though there are a few "bulk" schemes included in it, especially two in connection with power gas—for Cheshire and Belfast respectively. Nevertheless, it is admitted that, for the time being, work in the electrical industries is scarce, and the trade is depressed. The extension of electricity supply to Metropolitan suburbs is in hand; and several general electric lighting companies are extending their engagements. One of the Bills of which notice has been given is that of the Marylebone Borough Council, for the necessary borrowing powers to purchase the local portion of the undertaking of the Metropolitan Electric Supply Company. The Tramway Bills, of course, are numerous. On the whole, there is quite as much parliamentary activity in the electrical departments as circumstances indicate to be expedient at this particular juncture. We notice that the Matlock and District Gas Company are going for an Electric Lighting Order. It is hardly necessary to repeat what we have so often advanced in respect to the desirability of this proceeding on the part of some gas companies—not all, of course; but such as are best situated for performing a public service which would otherwise be lacking.

Another instance of the activity of municipal competition by means of electricity with a gas supply is afforded by the Electric Lighting Committee of the Hackney Borough Council. This is a matter that directly affects the Gaslight and Coke Company; and it should be interesting to follow the course of events from both sides. It appears that the Council have already, connected up, 147 motors aggregating 537-horse power, the energy for which has hitherto been charged at 2d. per unit. Since October, however,

the price has been reduced to 1½d. for all current taken in excess of 1000 units per quarter. And, besides, the Council are open to provide motors on the hire-purchase system, through a company. The terms are rather high; the price of a 7-horse power moderate speed motor being £5 4s. 11d. per quarter for four payments, or twelve quarterly payments of £2 0s. 4d. The motors on offer in this way range from ½ to 25 horse power. The last-named must be distinctly costly luxuries. At the same time, the probability that every such motor connected is so much business lost to the Gas Company has to be considered. The pressure of this form of municipal competition is increasing, and can only be met by corresponding enterprise on the part of any gas company subjected to it. Whether or not this enterprise will be shown in the case in point is what all gas people would like to know, after all that has been reported concerning the reorganization of the Company for business.

Our contemporary the "Electrician" devoted a good deal of space last week to an account of the Yorkshire Electric Power Company's generating station on the banks of the Calder, at Thornhill. The chief interest of this subject for gas engineers consists in the example it affords, that the much-vaunted advantages of the big gas-engine for generating electricity on the largest economic scale are not recognized by all independent electrical engineers. For this pioneer station of the Yorkshire Company, which is expected to be shortly in a position to supply power to consumers up to 6000 kilowatts, is equipped with Curtis steam turbines, not gas-engines. Mr. Parshall is the Consulting Engineer to the Company, and certain conclusions which he has adopted with respect to the feasibility of the "bulk" idea of electric power production and distribution are very pertinent to all such propositions. Mr. Parshall has reported that, after investigation had been made into the cost of power generation by individual users in the district of the Company, it was clearly recognizable that the only advantage possessed by the Company lay in the magnitude of the undertaking. That is to say, they had to make their saving in the lessened cost of generating electricity on the large scale which was open to them. Against this gain by magnification, whatever it might be, was to be set the cost of transmission, transformation, and distribution. The margin could not be large, in any circumstances; and inasmuch as the Company had to make rather a small beginning, the imperative obligation on the Engineer was to cut down all expenses as much as possible. Economy of capital was the first consideration; and Mr. Parshall's reading of this "categorical imperative" led him to decide for a turbine plant, on the grounds of low first cost, economy of space, and small steam consumption.

Take it as one may, this is dead-against the pretensions of the power-gas engine people. The particular pattern of turbine chosen is made by the British Thomson-Houston Company at Rugby. It is arranged for this station in units of 1500 kilowatts, and the dynamo is coupled directly, in the vertical sense, to the turbine. Economy of space can hardly go further. The turbine bed-plates only measure 10 ft. 6 in. square. There is no other type of prime mover anything like so compact as this. The steam consumption is guaranteed not to exceed 19 lbs. per kilowatt-hour, with dry saturated steam; and it will be considerably less under actual conditions, with 150° Fahr. superheat and with a 28-inch vacuum. Babcock and Wilcox boilers are to be used. The laying out of the plant appears to be admirably done with a view to economy of capital. Every set is complete in itself, so that each addition will bear its own capital cost; there being no initial capital outlay on account of future requirements. All that is wanted is business; but the works will not be ready much before the end of 1904. Another of Mr. Parshall's "bulk" electricity supply works—that of the Lancashire Company—is expected to be ready about the same time; so that the question of the need for these establishments should soon after be settled one way or the other.

There is much discussion just now among mechanical engineers as to the comparative merits of steam-turbines and reciprocating engines for large units; and, so far as an impartial observer can see, there is not a great deal of difference between the respective works costs—fuel and oil. The Newcastle-on-Tyne turbine station works at a cost of 0·18d. per unit sold for coal only, and 0·03d. per unit for oil and stores. On the other hand, Leeds, with steam-engines, is credited with a fuel cost of 0·28d. per unit. It must be admitted that the Newcastle figure is remarkably low. One cannot help thinking that this will take a good deal of beating, whatever the source of power brought against it. Assuming an equivalent consumption per unit sold of 100 cubic feet of power gas, which is probably much too low, it is obvious that such a supply could not be bought by the Newcastle Company to any advantage, unless sold to them at something less than 1·8d. per 1000 cubic feet. There is nothing in the market at anything approaching this figure. Meanwhile, it is rather impressive to observe that the partizans of big gas-engines are permitting judgment to go against them by default. The latest illustrations of the employment of large gas-engines, driven by blast-furnace gas, at Ilseder, Germany, appear in the current number of the "Electrical Review," and singularly beautiful pictures they are. But there is no gainsaying the fact that these big horizontal gas-engines take up a lot of room. Of course, in some cases this would not be an objection. It is commonly observed that on the Continent space appears to be no object. The engines in question are of the Oechelhaeuser design.

THE MONAZITE SAND CONCESSION.

THE latest advices regarding the monazite sand concession bring the history of the matter up to the opening of the tenders on Oct. 14. The original time fixed for this purpose was Sept. 14; but, by a decree of the Brazilian Minister of Finance, it was postponed for a month. Before giving the terms of the tenders received, allusion may be made to the points of local dispute which affect the contracts. The first refers to the question at issue between the Federal Government of Brazil and the Government of the State of Espirito Santo as to the point from which the 33 metres of foreshore "admitted to belong to the Federal Government" should be reckoned. This has now at last been determined by the Expert Commission to whom the matter was remitted. The Brazilian Minister of Finance has published the decree embodying the decision arrived at, from which it appears that the foreshore along which are the areas of the monazitic sands put up for public tender is to be reckoned as extending 33 metres inland from high-water level of an average tide. H. M. Minister at Rio de Janeiro is informed that the practical consequence of this decision will be that, for a certain portion of the year, the sands will only be workable for a few hours a day. But the settlement of this question does not dispose of the one as to the right of the States or of the Federal Government to the monazite sands on the foreshore, because the latest dispatch from H. M. Minister in Brazil says that it "is still being considered by the Supreme Tribunal." But the opinion of most people concerned in the matter is that judgment will be given in favour of the States.

In addition to the three tenders opened on Oct. 14, three additional ones are stated to have been presented at the Brazilian Legation in London, details of which had not (at the date of the dispatch) transpired in Rio; and H.M. Minister was informed that no decision could well be come to as to the acceptance or non-acceptance of any of the tenders until (at the earliest) the end of November. It may therefore be taken that, if the litigation referred to is not an impediment, the matter has by this time been, or is about to be, settled. Regarding the three tenders opened on Oct. 14, the principal heads appear in the last dispatch.

The first tender was by the firm of Cruz Brothers, of Victoria, Espirito Santo, and embodied the following conditions:—

(1) To commence work within the time stipulated. (2) To pay to Government 70 per cent. of the sale of the produce for five years. (3) To pay down £25,000 if the contract should be at its expiration renewed for another ten years.

The second tender was by a Russian engineer, resident in Bahia (for a period of six years from the date of the delivery of the plans), who undertook—

(1) To pay a premium of £5000 and 50 per cent. of the gross value of the sales to the Federal Government. (2) The minimum price to be fixed at £25 per ton for the rough sand, and £95 per ton of prepared or sifted sand. Should prices fall, 50 per cent. to be paid on the above values. (3) To ship annually a minimum of 1200 tons of rough or 250 tons of prepared sand. (4) Yield of thorium to be 6 per cent. per ton of rough sand. (5) If the yield is over 6 per cent., then an extra £1 for each 1 per cent. over that amount to be paid to Government. Payment to be made bi-yearly abroad. (6) Fiscal expenses to be paid in advance. (7) All machinery to be maintained at the expense of the contractor. (8) Accepts all conditions of the call for tenders. (9) Payment of the premium and £2500 as caution money and guarantee of the work being commenced according to the stipulations.

The third tender was by Alberto V. de Medeiros, representing a syndicate. The offer was as follows:—

(1) Caution money of £5000. (2) Premium of £10,000. (3) Repayment of the cost of surveys. (4) To pay the costs of fiscalization. (5) To pay Government 52 per cent. of the gross or 80 per cent. of the net profit on the sands exported. (6) To set up within two years a factory for working and preparing sands. (7) The price of sand in the rough to be fixed at £20 per ton, and work to commence within three months of the acceptance of tender. (8) The concession to be for eight years.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see page 633.)

BUSINESS on the Stock Exchange last week showed a fairly steady maintenance of the improved tone which had asserted itself the week before. But the ineradicable nervous element showed itself in slight oscillations from day to day, which hindered anything like a material advance. The opening was dull on war forebodings; the next day was more hopeful. After that, a reaction set in; but it lost its sting before the week was out. Still, on the whole, prices closed better than they opened. The Money Market relaxed steadily from start to finish, and closed with marked ease for short loans; but discount rates did not undergo a corresponding reduction. Business in the Gas Market was pretty well up to the average of late [the week, be it said, consisted of five working days only—the Exchange being closed on Saturday]; but the bulk of the transactions was in Gaslight issues, followed *longo intervallo* by South Metropolitan. It is difficult to say exactly what the tendency was, for in quotation alterations there were as many one way as the other; and the direction

seemed to depend upon the chance of a buyer being in evidence or no. However, there was no large movement either way. In Gaslight and Coke issues, the ordinary opened steady, and marked 89½ on Monday. But the next day it began to droop; and it got down to a special mark of 86 on Thursday. However, it showed a disposition to rally on Friday, and marked 87½; but still the quotation was down a couple of points. Of the secured issues, the maximum was the best; but it could not quite score a rise. South Metropolitan was not active, but very steady—opening and closing at 120⅓. Commercials were almost unnoticed. In the Suburban and Provincial group, little business was done; but Southampton and West Ham advanced, while Brentford old receded. Sheffields were a point higher locally. The Continental Companies were quiet and unchanged. Among the remoter undertakings, River Plate was higher; but Cape Town fell. Business in the Water Companies was generally quiet, except for some agitated dealing in New River, which brought the price down until, on Thursday, the stock changed hands once at 317—a falling-off indeed! Other stocks had less serious losses; but the arbitration proceedings of the week were calculated to have a rather depressing influence.

The daily operations were: Gas business was quiet on Monday, except in Gaslight issues, which were active. Cape Town fell ½. Tuesday produced no greater animation in Gas; and prices were easier generally. Gaslight ordinary fell 1. In Water, New River fell 20, West Middlesex 2½, and Grand Junction 2. The volume of Gas business was about the same on Wednesday. Gaslight ordinary was flat, and fell 1; but River Plate recovered ⅛. Thursday's dealings were all in Gaslight ordinary, at unchanged figures. Brentford old fell 2. Friday was steady, with a few improvements. West Ham rose 2, and Southampton 1½. In Water, Kent fell 5, and New River debenture 3.

PERSONAL.

After a continued service of more than thirty years as Accountant in the offices of the Portsmouth Water Company, Mr. SAMUEL GAMBLEN will vacate the post on the last day of the present year. In recognition of his long service, the Directors have granted him a pension of £150 per annum. His successor will be Mr. RICHARD BISHOP, who has for many years been connected with the collecting and financial departments of the Company.

Mr. MOUNTAIN B. WATSON, Manager of the Auchterarder Gas Company, has been appointed, out of 42 applicants, Manager of the Stranraer Gas Company, in succession to Mr. P. B. Watson, who is going to Wishaw. Mr. M. B. Watson's father was for 34 years Manager of the Stirling Gas Company. He himself has been Manager at West Calder, and only last May was appointed to Auchterarder. Since he went there he has been able to reduce the price of gas from 6s. 3d. to 5s. 10d. per 1000 cubic feet.

At the meeting of the Bath City Council last Tuesday, Mr. J. DENT YOUNG, Assoc.M.Inst.C.E. (whose selection for the post by the Water Committee was notified in the "JOURNAL" for the 24th ult.), was appointed Water-Works Engineer. There were 85 candidates for the position, of whom five were selected by a Sub-Committee to appear before the full Committee. But in the interval between the selection and the meeting of the full Committee, one of the candidates who was upon the short list (Mr. G. T. DERRY, of Portsmouth) was appointed Engineer to the Sutton Water Company.

We learn from the "American Gaslight Journal" that the last official act in connection with the resignation by General HICKENLOOPER of the position of President of the Cincinnati Gas and Electric Company took place recently, when a deputation from the Directors presented him with an illuminated address, embodying resolutions expressive of the sentiments of the Board, the officers, and the stockholders towards him. They set forth that his management of the business details of the Company had been performed with conscientious care and self-sacrificing devotion to duty, and that he had displayed unusual ability as an Engineer during his 31 years of active service.

OBITUARY.

SIR FREDERICK BRAMWELL.

IT is no exaggeration to say that the death of Sir Frederick Bramwell, which took place on Monday last week, after a few days' illness, has removed one of the most conspicuous figures in the ranks of civil engineers. For upwards of half-a-century, whether as practitioner, consultant, witness, or umpire, he had been engaged in most of the notable engineering undertakings for which legislative sanction was sought; and he will be greatly missed in Westminster, where his venerable appearance and kindly smile were well known to most people engaged in Great George Street and the vicinity.

Frederick Joseph Bramwell was the third son of Mr. George Bramwell, a member of a firm of City bankers, and the younger brother of Lord Bramwell, the Judge. He was born in 1818—the year in which the Institution of Civil Engineers was founded—and had thus reached the age of 85 at the time of his death. He appears to have displayed quite early a marked aptitude for mechanics; and in 1834 he was apprenticed to an engineer named John Hague. On the expiration of his apprenticeship, he remained for some years with him, but subsequently enlarged his experience in the service of other employers. This prepared him for commencing practice on his own account as a civil engineer. In the year 1854, he joined the newly-formed Institution of Mechanical Engineers; and in 1856, he was admitted an associate member of the sister Institution in Great George Street. Here he advanced rapidly. In 1862, he attained full membership; and from 1867 onwards he served continuously on the Council. In 1874, he was chosen President of the Institution to which he first attached himself, to the members of which he delivered an address, full of interest, on their duties as well as responsibilities. Ten years later, he filled a similar position at the Institution of Civil Engineers; and retained it till May, 1886. Sir Frederick Bramwell was an ardent supporter of the British Association for the Advancement of Science. He was twice President of the Mechanical Science Section—in 1872 and 1884; and he presided over the Association itself at the Bath meeting in 1888. His address on that occasion was a remarkable one.

Sir Frederick Bramwell's special qualities found recognition at the hands of public bodies and learned societies. In 1873, he was elected a Fellow of the Royal Society; and in 1881, he was appointed one of two lay members of the Ordnance Committee. He was on the Council and the Board of Management of the Royal Institution, of which he was made Honorary Secretary on the retirement of Sir William Bowman in 1885. He had also been on the Council of the Society of Arts from 1875, and for a short time he filled the position of President. On the foundation of the City and Guilds of London Institute, he was appointed by the Goldsmiths' Company one of their representatives on the governing body. He received from the Universities of Oxford and Durham the honorary degree of D.C.L.; and from the Cambridge and M'Gill Universities that of LL.D. Besides engineering, Sir Frederick took part in commercial affairs. He was Chairman of the East Surrey Water Company, and of the Kensington and Knightsbridge Electric Lighting Company, Limited. A knighthood was conferred upon him in 1881, and a baronetcy in 1889. As only Lady Bramwell and two daughters out of Sir Frederick's five children survive him, the latter honour becomes extinct.

On the assembling of the Court of Arbitration under the Metropolis Water Act, 1902, on Tuesday morning, Mr. Balfour Browne, K.C., as leading Counsel for the Water Companies, referred in terms of deep regret to the death of Sir Frederick Bramwell, which, he said, was a great loss, not only to the engineering profession, but to the gentlemen who were associated with him in the proceedings. Sir Frederick was to have been one of the witnesses in the New River Company's case; but he had not had an opportunity of calling him. He had hoped to have been able to call him in the Grand Junction case also. He was a man of great clearness of thought, profound common sense, and sparkling wit; and he had also a power of exposition which made him an ideal witness. Mr. Fletcher Moulton, K.C., representing the Water Board, associated himself with the reference. The President (Sir Edward Fry) said the late Sir F. Bramwell was well known to the Arbitrators, who quite concurred in what had been said. At the ordinary meeting of the Institution of Civil Engineers in the evening, the President (Sir William White) referred in feeling terms to the loss the Institution had sustained, and moved a long resolution, which had been adopted by the Council, expressing great regret at the loss, and conveying to Lady Bramwell and her daughters the sincere sympathy of the members of the Institution with them in their bereavement, and their high appreciation of the services rendered by Sir Frederick to the Institution and to engineering during his long and distinguished professional career. Sir John Wolfe-Barry, in seconding the motion, added a few sympathetic remarks. The resolution having been adopted, the business was adjourned.

The funeral took place privately on Friday, at Hever, Kent. While the interment was proceeding, a memorial service was held at St. Margaret's, Westminster, at the instance of the Institution of Civil Engineers. It was a fitting tribute by those among whom the deceased baronet professionally moved, and in the very midst of the busiest scene of his and their work. To mention all who were present would be to record the names of the most eminent in the engineering profession and many distinguished members of the Parliamentary Bar. Most, if not all, of the various engineering and learned societies with which Sir Frederick was closely identified sent representatives. The Institution of Civil Engineers were represented, among numerous others, by the President (Sir William White, K.C.B.), Sir George B. Bruce, Sir J. Wolfe-Barry, K.C.B., Sir Douglas Fox, Mr. James Mansergh, and Mr. Charles Hawksley; the Institution of Gas Engineers and the gas industry, by (there may have been many others in the large congregation) the President of the former (Mr. H. E. Jones), Mr. Corbet Woodall, and Mr. A. Dougall (the Past-President); the British Association of Water-Works Engineers, by the Secretary (Mr. Percy Griffith); and the Institution of Junior Engineers, by the Chairman (Mr. S. Cutler, jun.). Among the large engineering contractors was to be noticed Sir John Aird, Bart. Mr. Balfour Browne, K.C., Mr. Moulton, K.C., and several others of the Parliamentary Bar were observed; as well as a number of Parliamentary Agents and Solicitors—all of whom, in some way or another, had without doubt been professionally associated with Sir Frederick.

COMMUNICATED ARTICLE.

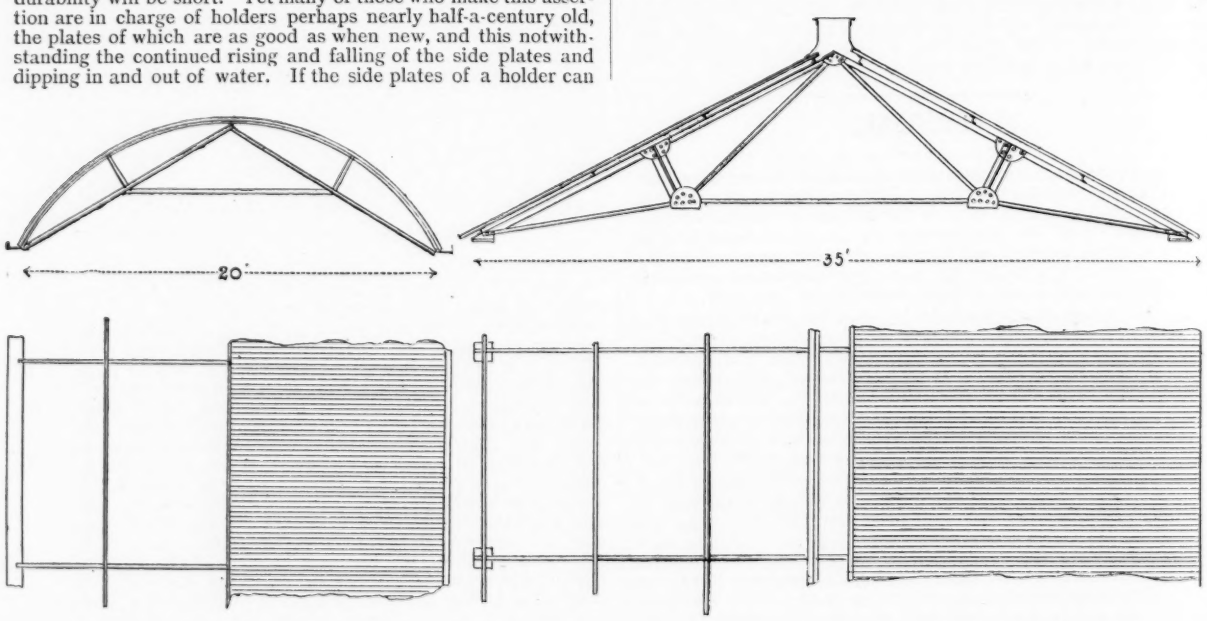
IRON ROOFS FOR GAS-WORKS.

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

I was particularly interested in seeing, a few weeks ago, some attention directed towards this subject, through the paper read by Mr. Cutler before the Eastern Counties Gas Managers' Association, and the subsequent discussion; having for the last ten or twelve years adopted iron roofs in preference to those covered with slates or tiles, for ordinary purposes in gas-works. The term is sometimes applied to roofs of which the framing—the principals and purlins—is made of iron, in contradistinction to those in which such parts are of timber, and without regard to the covering. But it is here employed as indicating roofs in which the covering as well as the framing is of iron. While the use of wrought iron for principals is universal, its utility as a covering material is not so generally known or appreciated; and therefore it is to this part of the subject that attention is now specially directed.

One objection, which, according to the usual order, is raised—chiefly by those who have not tried the system—may first be noticed. It is roundly asserted that the sheet-iron covering plates must be painted every twelve months, and that even then their durability will be short. Yet many of those who make this assertion are in charge of holders perhaps nearly half-a-century old, the plates of which are as good as when new, and this notwithstanding the continued rising and falling of the side plates and dipping in and out of water. If the side plates of a holder can be maintained for an indefinite period, why not an iron roof? To begin with, a *properly* painted iron sheet will last more like twelve years than twelve months; and for gas-works purposes it is as durable as, or more so than, galvanized sheet, which is certainly fairly impervious to damp and water, but if anything is more open to the attacks of sulphurous or ammoniacal vapours than black iron. The process of dipping softens the iron to some extent; and black iron is not only cheaper, but stiffer and stronger than galvanized.

But what is a *properly* painted sheet? An answer to this question is scarcely necessary in the case of the gentlemen who keep gasholder skins in good order, as the mere fact of their doing so involves a fair acquaintance with the subject. They need simply apply the same degree of skill and intelligence that is used in regard to the gasholder. The surface of the iron must be dry, clean, and not too cold; and the paint must be pure and finely ground. It is simply waste of time, if not worse, to lay paint on a cold, damp surface. In some works, the inside painting is looked upon as a wet-weather job which may be done at any season of the year. Good painting weather, unfortunately, has been a scarce article of late. During the past summer, we have barely had six weeks' duration in all of really favourable weather. Of course, one must make the best of opportunities; and it is sufficient to remark that paint laid on anyhow in any weather is not likely to be a success. We are often told that painting, like many other things, can be left to the intelligent utility man. This worthy will make a competent painter if properly instructed and trained, but cannot be expected to



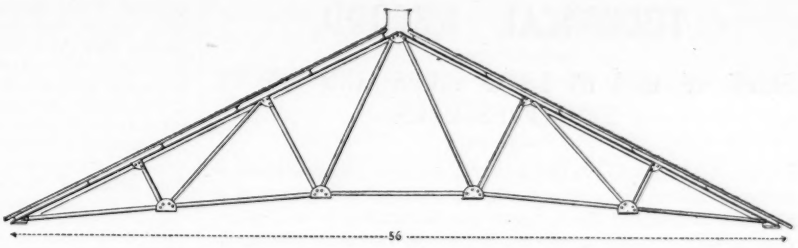
spontaneously develop such desirable qualifications. In the examples to be described, the sheets were coated with boiled oil at the works, and protected from the weather during transit. On delivery, they were at once transferred to the warm corner to be found in every gas-works, thoroughly cleaned with wire brushes, any accidental rust marks well burnt out with the blowpipe-lamp and touched with boiled oil, and while quite dry and fairly warm coated with the best red oxide paint by the medium of a painting machine. The machine is preferable to brushes, either for raw material or finished work, as it economizes paint, secures a more even coating, and penetrates crevices more closely than is possible with hand work. As already remarked, sheets thus treated will stand ordinary exposure for several years. The machine can, of course, only be used for flat-surface work. Bars, lattice work, &c., must be coated with the brush.

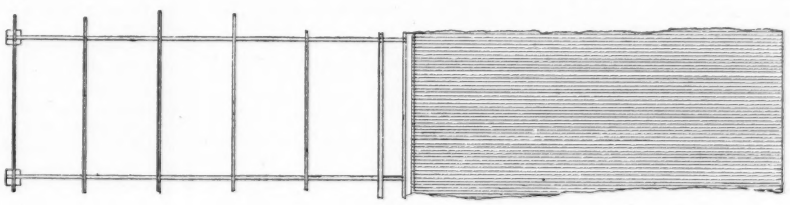
The special advantages afforded by this form of structure are cheapness, lightness, and absolute tightness as regards wind and weather. There is no trouble similar to that experienced with tiled or slated roofs, which are apt to be disturbed by heavy wind or rain; and the fall of individual slates or tiles is a serious peril to the workmen. The iron roof does not afford facilities for the accumulation of soot or dust, which gathers in considerable quantity on the underside of a tiled or slated roof, and drops from time to time, or is scattered all over the place in gusty weather. Both slates and tiles are apt to be fractured or softened by currents of hot air and steam; and the fastenings, whether wire or nails, are liable to be prejudiced by the same agents. The weight of the slates alone is 6 or 7 cwt. per 100 feet super., and tiles are considerably heavier; and if the laths are of iron (as is necessary in the case of a retort-house roof) 1 to 1½ cwt. must be added. But corrugated iron, No. 16 gauge, only weighs a little over 3 cwt., or less than half; and not only this, but it is stiffer and stronger, and consequently the struts or other supports can be farther apart. The principal rafters of a tiled or slated roof are usually strutted at about every 6 feet of length, and are not set more than 8 feet apart; but with corrugated iron, a length of 10 feet may be left unsupported, and the principals may be 15 feet apart. This means a considerable saving in the cost of each principal. Fewer numbers being required, the structure is necessarily cheaper. The ordinary single truss may be used up to 40 feet width; and, in addition to this, only half the number of principals are required. I have taken down the principals of a slated roof, and set them at double the distance apart for a corrugated iron roof, thus making them available for double the former area. No laths are required; angle-iron purlins 6 feet apart being sufficient. These considerations show that the saving in first cost leaves a good margin for painting, and for re-sheeting two or three times if necessary.

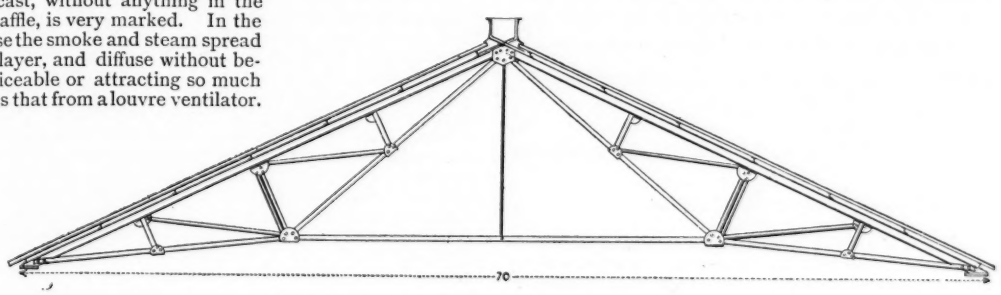
These points first came before the attention of the writer about twelve years ago, when considering the question of the renewal of a roof over an existing building, of wide span. The walls were somewhat slight in section; and it was thought that they would not stand the weight of a substantial roof of the usual pattern, without further strengthening. The satisfactory nature of this first departure led to further development of the plan. Several roofs of a similar nature, for retort-houses, coal-sheds, lime-sheds, and similar structures, have subsequently been erected; and though some have been standing ten years or more, they have not yet required re-placing. Four examples of these, having spans varying from 20 feet to 70 feet, are shown in the illustrations. The smallest is over a coal-shed; the second, 35 feet span, over a single retort-house; and the third and fourth are over double retort-houses. The largest represents the greatest width required under ordinary circumstances in a medium-sized gas-works. It leaves a clear space of 24 feet wide on each side of the bench; being sufficient to admit of mechanical drawing or charging.

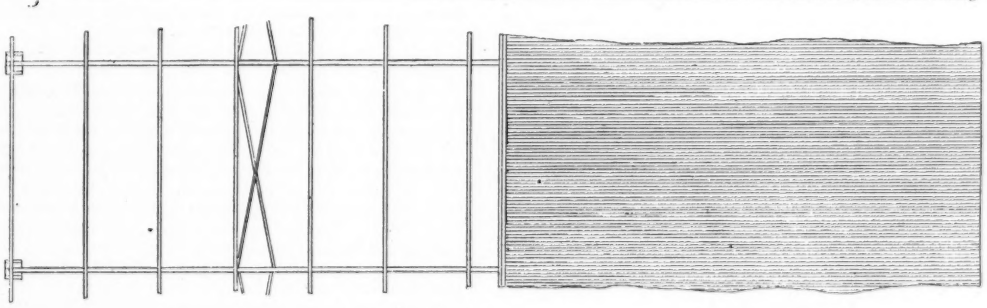
One or two special structural features may be noticed. In

accordance with the plan now generally followed, flat bar iron and gusset plates have replaced round rod with forked ends, eyes, and pins. A principal can be made up of only two sections—viz., tee iron for the rafters, two pieces of the same riveted back to back for the struts, and bar iron for the ties, double bars being used for the tie between the roof shoe and main strut on each side. The gusset plates can be cut out of $\frac{1}{4}$-inch or $\frac{3}{8}$-inch plate, and the same section can be used for making the wall plates or shoes; so that the construction of framing up to 40 feet span is a very simple matter, and not beyond ordinary smith shop resources. In place of the usual louvre pattern ventilator, a plain opening, framed by a structure of $\frac{1}{4}$-inch plate stiffened with angle iron, and 12 to 18 inches wide, is left along the ridge of the retort-house; and for other purposes square openings at about 10 feet apart, framed in a similar manner, and furnished with flap doors if desired, are provided. The advantage of providing a free upcast, without anything in the way of a baffle, is very marked. In the retort-house the smoke and steam spread in a thin layer, and diffuse without being so noticeable or attracting so much attention as that from a louvre ventilator.









In fig. 1, a method of construction is shown adaptable to positions where it is not desired to overlap the wall, as at the outside boundary of premises, or where one wall also forms part of an adjoining building of greater altitude, and extends above the roof. A run of ordinary channel iron, 9 inches wide, is laid in cement on the top of the wall, or else supported on corbels or brackets built into the wall, as may be required.

It is usual to build roofs much lighter in construction and using thinner sections of covering sheets; but the dimensions described, while securing strong stiff structures, are so cheap as to leave little margin for any substantial saving by reducing sections. A square of No. 16 gauge corrugated iron only costs about 30s.; and the labour of fixing, painting, &c., is the same irrespective of the thickness. A square of No. 20 gauge would cost approximately 20s., and one of No. 24 gauge 10s., but the thinner sections would require supporting at more frequent intervals.

The following are the dimensions of the roofs shown in the illustrations; and in each instance an elevation of one principal and a part plan covering two principals are given. In the case of roofs extending to more than six principals, diagonal wind-ties are fitted in addition to the framing shown. The main struts are connected together by tie-rods in the small and by cross-bars of tee section in the larger roofs.

—	Fig. 1.	Fig. 2.	Fig. 3.	Fig. 4.
Main rafters, T section	2×2½	3×4	3×4½	—
,, ,, I ,,	—	—	—	7×3¾
Struts, T section	2×2½	3×4	3×4½	4×4
,, ,, (double)	—	3×4	—	4×4
Main tie-bars, flat	2×½	2×½	3×½	4×¾
Intermediate tie bars, flat	—	—	—	2×¾
Shoe or wall plates	—	12×12	14×12	14×18
Purlins, L section	2×2½	3×3	3×3	—
,, ,, trussed	—	—	—	4×4
Cross bracing, T section	—	—	—	2×2½
Covering, black corrugated iron	16g	16g	16g	16g
Ventilator, sheet-iron plate	¼″	¾″	¾″	¼″

A Gas Retort and Producer.—The Deutsche Heizungs-Industrie Meininghaus Bachrodt and Co. have taken out a French patent (No. 332,522 of 1903) for a combined apparatus for simultaneously making illuminating gas from coal and fuel gas from coke. It consists, according to an abstract of the specification in the "Journal" of the Society of Chemical Industry, of a vertical furnace with fire-bars at the base and a charging orifice on the top, centrally through which extends a metal retort having also a charging aperture at its top and a discharging orifice beneath. Coke is fed into the furnace proper, where it is imperfectly consumed, so as to yield a power gas, which passes off through a suitable conduit; while the heat generated during the process raises the central retort to a temperature sufficient for the carbonization of the coal put therein. When the coal has been coked, it is drawn off from the bottom of the retort, and immediately introduced into the surrounding furnace. Several somewhat similar schemes are suggested.

Proposed Loan for Gas Purposes in Paris.—We learn from a communication by the Paris Correspondent of the "Financial News" that, as the result of some considerable discussion, the Municipal Council have resolved upon the issue of a loan of 100,000,000 frs., which is to be carried out immediately after the necessary legislative sanction for it has been obtained. The proceeds of the operation will be devoted to paying the cost of the reduction made in the price of gas, as well as to the increase of the gas workers' wages, from Jan. 1, 1903, to January, 1906, when the new system of supply is to be inaugurated. The loan will be redeemed within 35 years, beginning with 1906. A tax of 1½ c. will be levied on the standard price of gas supplied to private consumers; and the total receipts will form the interest and redemption fund. On no account will municipal resources be employed for this purpose, as, should the yield of the tax be insufficient, the amount will simply be increased. If it more than suffices, the redemption will be anticipated. The loan is entirely a distinct matter from the gas question proper, which, as mentioned last week, still awaits solution—as it has done any time these many years.

TECHNICAL RECORD.

FLOW OF GAS IN LONG PIPES AND UNDER HIGH PRESSURES.

In the "Journal" for the 24th ult. (p. 475) we published a communication from Mr. H. A. Humphrey explanatory of a formula he had previously given for publication in our pages, dealing with the flow of gas in long pipes. Several correspondents have called attention to the fact that there seemed to be a discrepancy between the formula last given and that which appeared in the issue of June 2 (p. 586), as will be seen from the following comparison:—

Nov. 24 $$u_1 = \sqrt{\left\{ \frac{g\,c\,T\,(P_1^2 - P_2^2)}{P_1^2\,(\zeta\frac{L}{m} + log_e\,\frac{P_1}{P_2})} \right\}}$$

June 2 $$u_1 = \sqrt{\left\{ \frac{g\,c\,T\,(P_1^2 - P_2^2)}{P_1^2\,(\zeta\frac{L}{m} + 2\,log_e\,\frac{P_1}{P_2})} \right\}}$$

In order that the matter might be thoroughly cleared up, Mr. Humphrey's attention was called to it; and he has been good enough to write: "The formula last published is the correct one. There should be no figure "2" in front of the expression $log_e \frac{P_1}{P_2}$. The error has arisen thus: In the general equation, we have—

$$\frac{d\,H}{H} + \frac{2\,g\,\Omega^2\,P}{c\,T\,W^2}\,d\,P + \xi\,\frac{dl}{m} = o$$

But on integrating this, the "2" in the second term disappears, and we get—

$$log\,H + \frac{g\,\Omega^2\,P^2}{W^2\,c\,T} + \xi\,\frac{l}{m} = Constant.$$

As a matter of fact, the error is so absolutely trifling, when we are dealing with long pipes, that the discrepancy is hardly likely to have been discovered—indeed, the whole term may reasonably be left out, as explained at the end of the example I worked out for you. Of course, the logarithmic term becomes more important where we are dealing with a higher ratio of pressure and shorter pipes."

RECENT DEVELOPMENTS IN THE CONSTRUCTION AND WORKING OF GAS-ENGINES.

By Professor D. S. Capper, M.Inst.C.E., of King's College, London.

[Honorary Members' Paper read before the Junior Institution of Engineers, Dec. 4.]

The gas-engine as a successful machine is the product of the latter half of the century which has just closed. And although the steam-engine with a century's start still holds the field, and has even burst into fresh vigour with the turbine, and the use of more highly superheated steam, it has already been considerably surpassed in thermal efficiency by its younger rival; and there are not wanting signs that, in practical convenience and general applicability, it may ere long also yield the palm to the internal combustion engine.

To properly understand the steps which have more recently been made in the development of the gas-engine, it will be necessary to briefly refer to the more important points in its earlier history. The earliest commercially successful gas-engine was the Lenoir of 1860, in which a mixture of gas and air was drawn into a cylinder and fired at about half-stroke, and then expanded—exhaust taking place on the return stroke. This was a double-acting engine—an explosion taking place each side of the piston every revolution; and the quiet running and steadiness of a steam-engine were retained with its other characteristics. Ignition was electric. The cost of running was, however, great, as it required about 100 cubic feet of coal gas per indicated horse-power per hour.

In the Paris Exhibition of 1867, its successor the Otto and Langen engine first appeared. It was a mechanically perfected improvement of an earlier engine invented by two Italians named Barsanti and Matteucci, and was so arranged that an explosion drove out a free piston like a projectile, which, in its upward flight, produced a vacuum, against which atmospheric pressure did work on the return stroke. The clutch applied to this engine was probably the earliest, and certainly one of the most beautiful, examples of a free wheel. In this engine, the gas consumption was less than half that of the Lenoir engine; but the economy was obtained at the expense of practical convenience—the engine being noisy, irregular, and uncertain in action.

It was then that Dr. Otto re-invented and developed mechanically the earlier suggestion of Beau de Rochas, that the systematic and controlled compression of the mixed gases before ignition could alone ensure satisfactory and economical working. From that date (1876) to the present time, the well-known Otto cycle has held the field against all competitors; and it is only now that there seems any probability of its pre-eminence being successfully challenged.

The cycle consists of: (1) An outward suction stroke; (2) a return compression stroke; (3) an explosion, at constant volume and partially at constant pressure, and subsequent expansion; and (4) an exhaust stroke—four strokes in all per explosion. The practical disadvantages of such a cycle as compared with that of the steam-engine are manifest. Some of these are: (1) It involves an engine considerably larger for the same power. (2) The velocity of the crank varies within much wider limits, as the explosive stroke is followed by three strokes in which negative work is done. (3) The noise and the strain on the working parts are much more considerable than is the case with a steam-engine.

Thermo-dynamically the much greater temperature range gives a large theoretical advantage to the gas-engine. But, on the other hand, it has only recently been found possible to practically approach the ideal Carnot cycle nearly as closely as the steam-engine does; and the very elevation of the maximum temperature, which is theoretically so beneficial, makes lubrication of the working parts impossible without artificially cooling them, and thus deliberately throwing away a very considerable portion—30 to 40 per cent.—of the heat supplied.

The improvements and developments which have taken place in the gas-engine in recent years may be said to be of two kinds: First, gradual and steady progress has been made in improving and rendering more efficient the Otto cycle. Second, attempts, hitherto only partially successful, have been made to replace the Otto cycle by others which will give more uniformity of crank effort—greater efficiency, and easier regulation. Outside either of these lines of development, there has been advance in the cheapening of the fuel used—cheaper gas and gas more directly suitable for heat production being employed. Successful attempts have also been made to utilize the valuable carbonic oxide gas which has hitherto been going to waste from the blast-furnaces, whereas it might supply thousands of horse power continuously night and day if only it were burnt in a gas-engine. It will be impossible within the limits of a paper such as this to do more than touch upon some of the examples of the more important developments in these several directions.

Taking first of all the development of the Otto engine, Messrs. Crossley have made rapid and great improvements in its construction and working. The original slide-valve has been replaced by mushroom exhaust and air and inlet valves, and by the incandescent tube igniter. Small engines are sometimes still fitted with metal tubes; the larger sizes, with special porcelain tubes in duplicate, so that liability to breakdown by the bursting of a tube may be said to be eliminated. These changes have rendered possible increased compression and explosion pressures and larger port areas. The 30 lbs. per square inch compression pressure of the earlier engines has given place to the 100 or 120 lbs. compression pressures of the later types. When using rich lighting gas, this involves very high explosion pressure, and special construction has had to be adopted to prevent destruction of the cylinder ends, and (to relieve the pressure on the exhaust-valve, which may be 40 or 50 lbs. per square inch at release) compensated valves are used. Higher compression involves reduced compression volume; and the ports and clearance volumes have to be reduced to a minimum. This makes it possible to reduce the area of cooling surface in contact with the hot gases at explosion; but nevertheless the temperatures are so high (3000 to 3500° Fahr.) that exhaust-valves and pistons, as well as cylinder barrels, have to be water-cooled.

Thermo-dynamically, the raising of the compression pressure makes the compression correspond more closely to the adiabatic return from lowest to highest temperature of the Carnot cycle; but the isothermal stage of the Carnot cycle has to be omitted almost entirely. Moreover, with a rich gaseous mixture, the compression cannot be carried as high as desirable from the theoretical point of view, as the critical ignition pressure and temperature for the mixture would be reached, and pre-ignition would automatically take place.

The successive increases in compression pressure, accompanied by other improvements, have resulted in the consumption of coal gas per brake horse power in the Crossley engine being reduced from 25 cubic feet by successive stages to 17, 15, and 13·5 cubic feet per brake horse power per hour. This means, with gas of a calorific value equal to 680 foot-pounds per cubic foot, a thermal efficiency on the effective work of 27·6 per cent. With gas from a producer or blast-furnace, the consumption would be greater in proportion to the quality of the gas. To overcome or to reduce the inequality of the crank effort, inseparable from the Otto cycle, heavier fly-wheels have been fitted to the smaller sizes of engine. In the larger sizes, the engines are built with two cylinders—one on either side of the crank-shaft; both connecting-rods working upon the same crank. In this way, an explosion every revolution can be obtained. Engines up to 500 to 600 indicated horse power have been built on this principle. Another type adopted by Messrs. Crossley for engines of large power is the inverted cylinder vertical type, with the cylinders placed side by side at an angle to one another and to the vertical, so as to resemble very closely the diagonal Thornycroft steam-engine.

This gives a very well-balanced engine. For very large powers four cylinders can be used, so as to obtain an impulse every stroke. The governing of the engine may be made to greatly assist the regularity of running; and in recent types an automatically regulating governor has been fitted, in which a perforated sleeve slides inside the admission-valve, under control of the governor. The sleeve is driven by an eccentric through a rocking-lever, with its fulcrum adjusted through a right-and-left handed thread by the governor. By this means, without the necessity for a very powerful governor, recent experiments have shown that, in the latest types of Crossley engine, between full load and no load, the speed can be kept constant to about 1 per cent. Electric ignition is only used by Messrs. Crossley where the conditions prevent a suitable jet for tube ignition being fitted. When electric ignition must be employed, they prefer an electric igniter fitted with a permanent magnet. When the Crossley engine is used for electric lighting purposes, the dynamo can either be coupled direct to the crank-shaft or be built upon the fly-wheel, so as to reduce the space occupied to the smallest dimensions.

The gas-engines manufactured by the British Westinghouse Company also work upon the Otto cycle. These engines are of the vertical type, and are built both single and double acting. Single-acting engines are made either with two or three cylinders side by side. In the two-cylinder type, there is one impulse every revolution; and with the three-cylinder type an impulse every two-thirds of a revolution. The crank effort is therefore very uniform, and the floor space occupied not large. The engines for electrical generating purposes are direct coupled to the dynamos. In the double-acting type, the cylinders are generally arranged one each side of the dynamos. The engines are built on the enclosed model, the cranks and connecting-rods being enclosed in a casing, which forms the framework of the engine, and contains an oil-bath.

Gas and air are admitted into the mixing-chambers through separate regulating-valves; and thence pass through a mushroom controlling valve into the cylinder. With very small clearance volume, the compression is high. Ignition is electric; and the igniter is arranged as a moveable plug carrying the necessary terminals. All valves are arranged so as to be readily accessible and removable for inspection. The governor regulates the quantity of explosive mixture; the proportion of air to gas remaining constant under all conditions of load. The centrifugal governor actuates the spindle of the admission-valve, and controls the charge. The admission-valve can be set to give any required proportion of air to gas, to suit varying qualities of gas. The engine is started automatically by compressed air. A reservoir is filled with compressed air on the previous run of the engine, or it may be charged separately. At starting, this compressed air is admitted to one cylinder, which it drives round until firing has taken place in the other cylinders. The engines may be also driven by petrol or gasoline; but in this case the fuel must be gasified in a specially provided gasifier, and a charge of gasified oil and air is thence sucked into the cylinder. In the largest sizes, the cylinders, exhaust-valves, and pistons are all water-cooled. In the double-acting engines, the two cylinders are generally set with cranks at 180°—an impulse taking place at every stroke. The valve gear is driven through worm gear on the main engine-shaft and a horizontal cam-shaft fixed on the outside of the casing; a vertical spindle transmitting the power from the worm on the main-shaft to the cam-shaft. The cranks in both types of engine are of the disc overhung type, fitted with balance weights. The main bearings are in many cases lubricated by forced lubrication.

With the introduction of producer gas, and the use of blast-furnace gas, both of which are of poorer quality than coal gas, and therefore require cylinders of larger diameter, engines of much higher power are being constructed by a number of firms. Restricting ourselves for the moment to the engines which work on the Otto cycle, the following will furnish some of the more important examples of large engines at present in use. The Premier Gas-Engine Company, Limited, of Sandiacre, have specially developed this type of construction; and gas-engines of 500 brake horse power have been working for some time. In a paper read before the Institution of Mechanical Engineers by Mr. H. A. Humphrey so long ago as 1900,* the results of the trial of such an engine are given working with Mond gas. The overall efficiency— $\frac{\text{E.H.P.}}{\text{I.H.P.}}$ —was 70 per cent., and the consumption 52·09 cubic feet of Mond gas per indicated horse power per hour, or 74·42 cubic feet per effective horse power per hour. This corresponds to a thermal efficiency of 30·38 per cent. on the indicated horse power, or, including engine friction, 22·87 per cent. and 25·59 per cent. respectively—including and excluding the value of the heat carried off in the vapour. This firm employ single cylinders up to 250 indicated horse power, and two tandem cylinders up to 1200 indicated horse power; and above 1200 indicated horse power, they are prepared to build double-tandem engines with four cylinders. A scavenging charge of air is supplied from a separate cylinder, which tends to prevent pre-ignition. The largest engine made by this firm of which the writer is aware is one with 38-inch cylinders, and with a piston speed of 750 feet per minute. Where steadiness of running is of paramount importance, governing is accomplished by reducing the quantity of gas and eliminating blank strokes. Heavy fly-wheels constructed for high velocities, coupled with this system of governing, ensure great steadiness in running.

Probably the largest engines on the Otto cycle hitherto constructed have been made by the Société Cockerill, of Seraing. Engines with two-tandem cylinders, 51 inches in diameter, have been made by this firm, and develop 2500 indicated horse power. The engines are known as the "Simplex" engines. They are built of a specially strong design, and are arranged for driving by blast-furnace gas. The fly-wheels are of the built-up type, so as to run at high rim velocities. Electric ignition is adopted. A benzine carburettor is used for starting; and the fly-wheels are fitted with barring gear, worked by an electric motor where the conditions permit. All the main valves are placed at the lowest part of the cylinder, so as to facilitate cleaning. The Cockerill Company are also building some double-acting engines. Messrs. Fielding and Platt build both horizontal and vertical engines—the former, up to 300 brake horse power; the latter, up to 780 brake horse power. High piston speed is adopted in these larger vertical engines; 900 feet per minute being reached with the four-cylinder type. These are of the enclosed design; and an explosion every revolution is effected through a piston valve, so that air and gas are cut off in corresponding proportions—a constant mixture being obtained.

From this brief survey, it will be seen that the Otto cycle is, still, more extensively employed than any other; its drawbacks being overcome by heavy fly-wheels, careful governing, and the grouping of a large number of cylinders round the crank-shaft in such a manner as to reduce the floor-space occupied to a minimum. Further, by improved arrangement of parts, reduction of clearance, and increased attention to minimizing the area in contact with the hottest gases and an accompanying increased efficiency and extent of cooling jacket, the engine is showing signs of developing into a double-acting engine. It has thus been found possible to obtain a direct gas-driven electric generator set, occupying no more space than a steam-driven set of equal power.

To still further increase the power in a given space and to improve the cyclic regularity, has been the aim of numbers of experimenters from the commencement of the gas-engine history. Perhaps the earliest and best-known instance of practically successful variation from the Otto cycle was the engine designed by Mr. Dugald Clerk. In this engine, first introduced in 1876, the aim was to obtain an explosion every revolution with a single-acting engine. All the portions of the four-stroke Otto cycle were adopted; but the suction and compression strokes were removed to a separate pump cylinder, so that only explosion, expansion, and exhaust were carried out in the main cylinder. A further feature adopted by Mr. Clerk was the introduction of a scavenging charge of pure air, to sweep out the exhaust products before the new explosive charge was admitted. To facilitate this cleansing operation, the exhaust ports were removed from the combustion ends, and placed in the side of the cylinder; and the main piston was arranged to serve as its own exhaust-valve. When the scavenging charge had passed through, the gas supply was admitted, and the explosion therefore took place at the back of a cushion of pure air. In this way, perfect combustion was ensured, and contact with the cooling surfaces was reduced. This engine did not supersede the Otto cycle engine; but it possessed important features which may lead, with present improved methods of manufacture, to wide developments.

This Clerk engine has recently been re-introduced with modifications by Messrs. Körting; the manufacture in this country being undertaken by Messrs. Mather and Platt. The Körting engine is made double acting; the exhaust port being placed in the centre of the cylinder. An elongated piston acts as its own exhaust-valve at either end; exhaust at one end corresponding with maximum compression at the other. Ignition comes at the inner dead-point. At the outer dead-point, the discharge of the exhaust products and admission of the fresh charge occurs. In order to completely get rid of the exhaust products during the short period of rest and travel through the exhaust-ports at the end of the stroke—a period corresponding to about 90° of the crank-circle—pure air is driven into the cylinder from an air-pump. A separate gas-pump then forces the gas in definite volume into the cylinder; and the main piston compresses the mixture on its return stroke. The length of the piston is equal to the stroke, less the length of the exhaust ports; the exhaust port being about one-tenth of the length of the stroke. The gas and air pumps are arranged tandem on a common piston-rod, so that their strokes are identical in length; and the proportion by volume of air to gas is thus kept constant. This necessitates the area of the pumps being proportional to the poorest quality of gas employed. If the gas increases in richness, it must be diluted with inert gas or air to an amount sufficient to reduce its calorific value to that of the poorest gas used. The channels through which the gas and air are pushed to the admission-valve unite at the valve, so that the explosive mixture is only formed at the valve. These channels are made long, so that a considerable volume of both air and gas is forced under slight compression into these passages, and accumulates there until the valve is opened. The pumps take in and discharge the charge of air and gas through slide valves, which are differently set for the two pumps; the air-pump takes in air throughout the complete stroke.

* See "JOURNAL," Vol. LXXVI., p. 1509, Vol. LXXVII., pp. 206, 398.

In the gas-pump, on the other hand, closing to admission and opening to discharge does not occur until about half of the outward stroke has been completed. The air-pump therefore first begins to discharge, and fills all the passages right up to the main admission-valve, and back to the slide-valve of the gas-pump, with pure air. When the gas-pump begins to discharge, therefore, it is met by this air at somewhat higher pressure, and is kept back until a considerable volume of air has passed into the cylinder; and the pressure, being thus reduced, the gas can overcome its resistance and follow the air into the cylinder. The two pumps thereafter discharge together, and at the same rate—ensuring a uniform mixture of gas and air. By this arrangement, a cushion of pure air is first admitted, replacing the exhaust products; and this is then followed by a uniform mixture of gas and air. Regulation of this mixture can be obtained in one of two ways—either by altering the motion of the gas-pump slide-valve, by driving it through two eccentrics like the reversing motion of an ordinary steam-engine (this necessitates a powerful governor), or a bye-pass between the suction and discharge passages of the gas-pump may be opened or closed to any required extent by the governor. In this way, the discharge from the gas-pump is kept constant; but some of its discharge escapes back to the suction side for a longer or shorter portion of its discharge stroke. Air from the air-pump therefore replaces that portion of the normal gas charge; but when gas is finally discharged to the cylinder, the mixture is in the same proportion as before. The inlet-pipes are designed to prevent any mixing of the combustible mixture with the pure air layer, and the two are retained more or less in separate layers in the cylinder. As the time of ignition varies with the richness of the gas (the poorer the gas the earlier the required ignition period), four electric igniters are fitted, two on each side of the cylinder—one of each pair being near the inlet-valve, the other, at the end of the piston in-stroke. The electric inductors are driven by a lay shaft geared from the main-shaft, so that, by altering the gear, the time of ignition can be varied according to the gas used. At starting, ignition is delayed so as not to take place till after the dead-point; thus preventing any pre-ignition when starting slowly. The engine works with a compression of 10 to 12 atmospheres. The starting arrangement consists of a small compressor and air vessel, charged, if the conditions are suitable, by an electric motor. Compressed air from the receiver is admitted through a slide-valve on the side of the cylinder when starting, and the engine starts off after one or two revolutions. As the pressure of the air required to start the engine never exceeds about 10 atmospheres, which is less than the maximum compression pressure, there is no possibility of air leaking in at ignition, and so producing a miss-fire. To cool the charge and surfaces so as to prevent pre-ignition, the combustion chamber surfaces are arranged with ribs, projecting into the water circulating chamber, and the piston is water cooled through the hollow piston-rod. The mean rise of temperature of the cylinder walls is, therefore, not much, if at all, higher than with steam-engines; and the cylinder can therefore be efficiently lubricated. As the exhaust products are pushed out alternately in opposite directions, the exhaust ports are cleansed, and there is little or no tendency to injurious deposits. A considerable number of engines of 1000 brake horse power are at present in course of construction on this principle; and a twin cylinder 2000 brake horse power engine is also being made. The largest power hitherto developed in one cylinder on this type of engine is the equivalent of about 700 brake horse power.

Although chiefly perfected as an oil-engine, the engine invented by Mr. Diesel was designed by him to work with gas, oil, or powdered coal. Its arrangement and design are so original, and its possibilities so great, that it is worthy of notice even where gas-engines proper are the subject of discussion. There seems no reason, moreover, why the engine should not be well adapted, with slight modifications, for use as a gas-engine. Mr. Diesel's original conception was to build an engine which should work on the Carnot cycle, with isothermal addition and rejection of heat, and adiabatic compression and expansion. Apart from the fact that in a gas-engine it is the gas and not heat alone (as in the Carnot ideal) which is admitted and rejected each cycle, Diesel soon found that actually to follow the Carnot cycle is impracticable. The isothermal compression has to be omitted—an approach to adiabatic compression alone being practically attainable; and if all the heat were added isothermally, the area of an indicator diagram would be so small that the engine would become altogether too large for a given power to have any chance of commercial success. For a similar reason, it is not economically possible to carry expansion down to the lowest pressure of the cycle, as a cylinder elongated out of all proportion to the work gained would result. But with the isothermal compression stage left out, and the top and bottom peak and toe of the diagram cut out, it is possible to build an engine to follow very closely the Carnot cycle. This result Mr. Diesel has achieved.

The leading characteristics of this engine are the following: One form of the engine works on the Otto cycle. But, instead of the combustible mixture being compressed in the cylinder (as in the ordinary Otto engine), air alone is admitted, and compressed to a very high pressure; and the fuel is then injected into air thus highly heated by compression, and spontaneously ignites. The cycle of operations is this: First, a suction stroke in which air alone is drawn into the cylinder; second, approximately adiabatic compression of the air to a pressure of 700 to 900 lbs. per square inch, and a temperature of 1000° C.; third, gradual and comparatively slow injection of fuel into the cylinder at constant pressure and during approximately adiabatic expansion; and, fourth, exhaust stroke. The engine has also been built to work with an impulse every revolution.

The injection of the fuel into the cylinder at the end of the compression enables combustion to be either lengthened or shortened to any desired extent, and effectively prevents any possibility of pre-ignition. The mechanical arrangement is this: A pair of reservoirs are filled with compressed air. One of these is the air-blast reservoir, with a pressure of 40 to 55 atmospheres, or 100 to 200 lbs. per square inch, above the pressure at the end of compression in the main cylinder. The second reservoir is filled from the first by an overflow escape valve, and serves as a starting reservoir. The air-blast reservoir is supplied by a small air-pump driven by levers from the connecting-rod end; the suction to the pump being taken from the main cylinder just before the end of compression. With the main piston, therefore, this pump acts as a two-stage compressor; and the necessary air-blast pressure is very economically obtained—only some $\frac{1}{2}$ to $\frac{3}{4}$ per cent. of the effective work of the main cylinder being absorbed in this duty. The engine is generally built on the enclosed principle; and the open trunk piston communicates directly with the crank chamber, which contains an oil-bath for the lubrication of the crank and connecting-rod end. As the governor controls the supply of fuel, and can vary it to suit the load with great nicety, the velocity of the crank can be kept very uniform. The engine will no doubt prove most valuable where uniformity of speed is essential, especially when it has been successfully working in larger power units.

The economy is remarkably constant for all the various sizes hitherto constructed. At present, engines of 80 and 160 brake horse power have been successfully working for some time, and the construction of engines up to 1000 brake horse power is in contemplation. The thermal efficiency (leaving the mechanical losses out of account, and reckoning on the indicated horse power) hitherto attained has been over 38 per cent.; and the corresponding efficiency overall is 28·8 per cent. Numerous trials by eminent experimenters have been made which confirm this performance. It seems, therefore, quite possible that the Diesel system of working may lead to still greater economy; and, if so, its general adoption may very probably be found advantageous. To apply it to gas fuel should not require much modification; and if it is in that form successfully developed, the object—to carry out which Sir William Siemens so long worked unsuccessfully—will be realized, and a gas-engine with constant pressure ignition will be a practical reality.

As increase of compression is accompanied by increased economy, the tendency, as already stated, is towards gradually increased compression, until with the Diesel engine compressions of 900 lbs. per square inch are employed. The highest explosion pressures are about 1000 lbs. per squre inch. Such pressures involve very heavy castings with thick walls, and efficient cooling becomes difficult. Under these circumstances, the type of engine recently invented by Messrs. Vogt and Recklinghausen, and at present in course of manufacture for commercial purposes, is welcome. This engine is of novel design. Two vertical explosion chambers form the prolongation at right angles of the horizontal cylinder, and communicate with its either end. The cylinder and a considerable portion of these chambers is filled with water, or a mixture of glycerine and water, and the explosion takes place above the fluid surface. The upper ends, or compression spaces, of these chambers are conical in form; and the explosive mixture can thus be compressed to a very accurate degree of pressure by a variation in the amount of fluid contained in the cylinders. The liquid, moreover, comes in contact with the hot surfaces, cleanses and cools them in the most effective manner, and interposes an incompressible buffer between the hot gases and the working piston. The reciprocating piston is thus never in contact with hot gases. Lubrication is easy, and any foul deposit from the combustible mixture is washed off and ejected as scum.

The working cycle of the engine is as follows: The crank being set at about 20° over the dead-point, air is admitted from a compressed air reservoir previously charged, and is passed through a valve alternately into one and the other combustion chamber until an explosion occurs, when the air pressure is automatically cut off, and the engine runs with maximum charge until the normal speed is reached. Following the explosion and expansion, the exhaust valve opens; and its closing being under the control of the governor, it can be advanced or retarded through a wide range. While the exhaust valve is open, a scavenging charge of air is admitted and blown through from the compressed air pump; and the moment the exhaust closes, the fuel is likewise blown into the compression space and compressed, and then is fired by electric ignition at the dead-centre.

The governor not only controls the period of opening of the exhaust valve, but also determines the period at which the fuel-injection valve is opened; so that the opening always immediately follows the closing of the exhaust. The governor also controls and throttles the intakes to the pumps, so that their delivery is correspondingly diminished. The water in the cylinders is constantly renewed by pumps through a balanced rotary valve, which is turned by a valve motion into such a position that communication is always open to the side of the cylinder on which

there is compression. The compression pressure is kept constantly the same, whatever the amount of fuel injected, by means of a spring-loaded relief valve, which allows the fluid to escape as soon as the required pressure is exceeded. By this system of governing, the fuel used is automatically adjusted to the load, and at the same time the compression is adjusted, so that it always remains constant whatever the injected charge. This engine has as yet only been constructed and run in small sizes with gas as the fuel; but the economy obtained, and the smoothness of running, were such as to promise very striking results when larger sizes are in use. The engine, it will be noted, is double acting, and runs on a two-stroke cycle; and the diagrams obtained are remarkably uniform, whatever the richness of the gas employed. The compression can be very easily regulated during running by adjusting the spring of the relief valve, so that a compression suitable for any quality of fuel can be obtained. It is possible also that powdered coal may be utilized in this engine, as the scum and dirt can be readily removed by allowing a proportion of the fluid to escape.

It is impossible within the limits of a paper such as this to deal with all aspects of recent developments; but a few words must be said as to the advancement resulting from the use of producer and blast-furnace gas within recent years. For some years the Dowson gas plant, working with anthracite coal of large size, has been in use; and in this way, the consumption of fuel per indicated horse power per hour has been reduced to less than 1 lb., as compared with 1½ to 2 lbs. with a first-rate steam-engine of equal size. By recent improvements, it has been found possible to utilize smaller fuel with the Dowson and other plants of like design. By this means, the cost of producer gas has been reduced to a low figure compared with coal gas. For large powers—it is not found economical or convenient with plants much under 500-horse power—Dr. Mond has recently introduced a plant which produces gas from ordinary bituminous slack; the tarry deposits being efficiently removed by a complete and simple system of scrubbers. By utilizing the otherwise waste heat in the cooling water for raising the steam necessary to saturate the producer blast, great heat economy is obtained, and at the same time the ammonia in the exhaust products can be recovered.

The method of working is as follows: The fuel is fed into a producer-bell, where it is heated, and the volatile constituents pass down into the hot fuel; and so the tar is destroyed and converted into a fixed gas. The slack thereafter passes down into the producer, where an air-blast saturated with steam at 185° Fahr. plays upon it. About 2½ tons of steam per ton of fuel are required for this purpose. This keeps the temperature of the producer down, and prevents the formation of clinker and the destruction of the ammonia. The decomposed portion of the steam supplies a volume of about 29 per cent. of hydrogen to the finished gas. The gases are cooled in a regenerator by the incoming air supply to the blast, which is thus heated before passing to the furnace. The products are then passed through a washer, in which they meet a water spray produced by revolving dashers. In this washing, the steam and gas are cooled down to about 194° Fahr. by the formation of additional steam, which approximately saturates the gas at that temperature. It finally passes up through a lead-lined tower with a large surface of tiles, where it meets with a flow of acid liquor containing sulphate of ammonia with some 4 per cent. excess of sulphuric acid, and forms further sulphate of ammonia; so that free acid is constantly added to the circulating liquor, and sulphate of ammonia is withdrawn and evaporated to give solid sulphate of ammonia. The gas is thereafter passed through a cooling tower with a downward flow of water, and further washed and cooled. The cooling water is raised in temperature by the condensation of the steam in the gas, and the hot water resulting is used to heat the air-blast from the blower. The blast is therefore converted into hot air saturated with water vapour. The steam production necessary is to this extent reduced, and heat saved. With a producer of this form, gas can be made at about 2d. to 4d. per 1000 cubic feet; and the cost of power with large engines using this gas has been reduced, as given by Mr. Humphrey, to so low a figure as 0·048d. per kilowatt hour, allowing a dynamo efficiency of 93 per cent.

From the above facts, it will be gathered that the gas-engine has been, by recent improvements in construction, brought to a position in which, in economy, it surpasses the steam-engine; and in regularity of running, steadiness, size, and handiness for given power, it approaches very closely, and promises to surpass, the steam-engine also. Compound gas-engines have been tried by Messrs. Crossley Bros., and by other makers also. But although these have been successfully worked, the gain has not been commensurate with the added cost; and they have therefore not been adopted as a commercially possible type. If the reciprocating engine were to give place to a rotary turbine, there is little doubt that its future bids fair to equal, probably to surpass, the steam-engine for universal applicability. Many experimenters are working on the problem of a gas-turbine; and there are even rumours that a solution has been found. There is little doubt that, as Mr. Parsons has converted the engineering world to the real genuineness of an economical steam-turbine—though many of us had from frequent disappointment learned to regard a rotary engine as approaching perpetual motion in the improbability of its successful achievement—so the gas-turbine will in the future (possibly the near future) be an accomplished fact. The place the reciprocating gas-engine has already won is proved by the significant fact that even firms which have created the demand, and met the supply, for high-speed steam electric generators are almost without exception experimenting with gas-engines as the coming thing which will supply the second, if not the first, string to their bow.

[The paper was illustrated at almost every point by means of some excellent lantern slides.]

Discussion.

Mr. Rounthwaite thought that most engineers who studied the gas-engine ten or twelve years ago could not then help agreeing with Mr. Dugald Clerk that the Otto cycle would ultimately have to go. It was, however, a curious example of the effect of the patent laws that the expiry of the Otto patents amounted to—he could not call it a national disaster, but it had a serious effect on the progress of the gas-engine, as so many makers at that time abandoned their attempts to devise a method of getting more frequent explosions. They, as it were, then threw up the sponge, and took to manufacturing engines upon the Otto cycle, which retarded the progress of the gas-engine by, at any rate, eight or nine years. He asked Professor Capper as to the fluid contained in the Vogt engine—whether it required to be constantly added to, and was any of it evaporated, or discharged by the exhaust-valves. He also mentioned that he had under his charge (for the London County Council) a considerable number of gas-engines, the largest of which was about of 260-horse power. At their new storm-water pumping-station, gas-engines were also used, because it was necessary to have them at work in twenty minutes in the case of a storm coming on. He moved a vote of thanks to Professor Capper.

Mr. A. W. Marshall seconded the proposition; and, in his remarks, said he thought it a pity that it was necessary to have such large fly-wheels for gas-engines. Considering, too, the gas-engine was the prime mover of the future, it was curious that, so far, there appeared to be no easy means of speed regulation—he meant by this, in getting a variety of speeds to accomplish work such as was done with the steam-engine. It had been achieved to a limited extent by the gas-engine; but that was all. He referred to the Atkinson engine as having been a clever attempt at improvement; and said that what Mr. Atkinson aimed at was to get the suction-stroke of the engine shorter than the explosion-stroke. To him the engine seemed to open up the possibility of being able to obtain the extension of the working stroke, giving analogous advantages to those claimed for the steam-engine.

Mr. T. C. Morewood, speaking on the point regarding the liability to breaking of the porcelain tubes, said they frequently found flaws in the tubes which could not very well be seen until they were put in. Only that morning, he had put in four tubes one after the other, and each had blown out; but finally he got one to stand. Of course, the flaw might be caused in the packing, or through being kept in stock and being handled. He inquired if Professor Capper could give them some idea of the most efficient temperature for the cooling water.

Mr. R. W. A. Brewer stated that the Willans engine was one of the best he had come across. He had seen it in course of construction; and it was very much like the Willans steam-engine. The buffer cylinder was made use of for compressing air which was utilized as a scavenger. He should much like to have heard more about scavenging from Professor Capper. It was a most essential thing in gas-engines, especially large ones; and it was absolutely essential when using poor and blast-furnace gas. Those who had read Mr. H. A. Humphrey's paper, to which the author had referred, would have noticed the considerable increase in compression which was obtainable in the Premier engine over a Crossley engine which had not a scavenger. As to the Crossley valve, he thought the one designed by Dunlop was better, because in the Crossley exhaust-valve the spindle, which was of large size, ran across the exhaust-passage, and blocked it up to a considerable extent. Regarding gas-producers, it would be very advantageous if a small-sized bituminous one were brought out.

Mr. S. V. Cooke offered a few explanations and views on the Oechelhaeuser and Körting engines, and referred to the objections that he saw to the valve introduced by the last speaker. As to Mr. Marshall's reference to large fly-wheels, he pointed out that he could not have an engine working on the Otto cycle without large ones. The Atkinson differential engine was a marvel of ingenuity; but the number of working parts in it precluded it being made a commercial success.

Mr. Chamberlain pointed out that the suction gas plant for generating gas for driving engines had come to the front very much lately. It cost as low as ⅛d. per horse power, and so was very economical. He believed it could be fitted to engines of over 100-horse power, by utilizing the energy of the exhaust for generating steam.

Mr. W. Paterson spoke as to the possibilities of utilizing the heat of the exhaust and water-jacket in generating a gas from a volatile liquid, and introducing it for working another engine. He believed the gas-turbine would come to the front.

Mr. G. Allingham also referred to the suction producer; and he thought its simplicity would lead to its extended use. It was merely a slow-combustion stove; and the engine itself sent the air through the glowing fuel. Steam was easily produced by dropping water into the stove or ash-pit below the stove, so that a

little steam was sucked in with the air. The gas was made automatically just as the engine required it.

Mr. J. W. Nisbet inquired whether there was anything more up to date than the condensing-tanks supplied with gas-engines, and alluded to difficulties experienced with them.

Mr. Merritt asked Professor Capper whether he had any experience with Tangye engines. He himself had charge of two of 150-horse power, coupled to dynamos; and he had found certain difficulties with them—first, through oil creeping up from the crank chamber into the cylinder, including the ignition gear; and, secondly, in connection with the governor, which was simply worked by a butterfly valve. He had found that this stuck very badly, owing to grit—perhaps from the gas or from the explosion of the gas when it back-fired; and it caused very bad governing indeed. Sometimes they got as much as 20 per cent. variation. The other trouble was the one of back-firing. In an electric light engine, it was very essential that they should have constant speed; and occasionally one of these engines back-fired so seriously as to drop the speed down to one-half, and so practically "shut up" the engine altogether.

The Chairman (Mr. Samuel Cutler, jun.), in bringing the discussion to a close, said there were a large number of members present who, like himself, regarded the gas-engine as the most economical and convenient means of generating motive power. A practical illustration of how rapidly the gas-engine was superseding steam power plant could be seen by visiting Millwall, where a variety of industries were carried on. One had only to take a thirty minutes' walk along the main road when he would pass sixteen industrial concerns, having their works on the river. These were mostly engineering establishments of large size. It was a fact that out of these sixteen works, thirteen relied upon the gas-engine for power for driving their plant. One reason for this was not far to seek. The whole of these works were situated within the district of the Commercial Gas Company, who, to meet the demand for motive power, allowed the liberal discount of 20 per cent. off the ordinary selling price per 1000 cubic feet. He did not wish to argue that the cost of running a gas-engine was cheaper by coal gas than by producer gas; but, when they came to consider the higher calorific value and the greater efficiency of the coal gas, the conveniences of an unlimited supply of rich gas without trouble of any sort, and then all the advantages and disadvantages of generating producer gas on their premises, he thought it would be found that the advantages were pretty well balanced—especially for installations up to 150-horse power. In conclusion, he expressed the deep indebtedness of the members to Professor Capper for the paper, and for the great interest he took in the Institution.

The vote of thanks proposed by Mr. Rounthwaite was heartily carried.

Professor Capper, in reply, first expressed his appreciation of the way the members had received his paper. In the course of his subsequent remarks, he said that Mr. Rounthwaite's observations about the patent laws were extremely interesting; and it must have struck many of them that the patent law in the respect mentioned worked in exactly an opposite direction to what they would have expected it to do. While the patent of the Crossley engine was in force, everybody was trying to invent another cycle; and the marvellous thing, to his mind, was that a cycle was not invented to supersede it. He thought it was very much to the credit of Messrs. Crossley that they were able to retain the practical control of the gas-engine market by the wonderful way in which they developed the Otto engine, and the marvellous manner in which they made it a commercial success. It was due to them that, in spite of the inducement the patent law gave, no other cycle touched the Otto in commercial value while the patent was in force. Then Mr. Rounthwaite asked him (Professor Capper) about the Vogt motor—whether the contaminated fluid would require renewal constantly. This was so. There was a certain proportion of the fluid discharged at each stroke, and a certain portion of it was evaporated by the heat of combustion. Therefore cooling took place by the evaporation of some of the liquid which had to be renewed continuously. The effect of the steam formed upon the pressure was quite appreciable, and really helped in the economy of the engine. While he was speaking about this motor, he could answer the question as to whether there was anything better than tanks for cooling purposes. He (Professor Capper) thought that the system adopted in the Vogt motor was better; and his opinion was that, if the Vogt motor could be developed for large sizes, there was a great future before it. He certainly first approached this motor with some degree of scepticism. One would have thought the water in the cylinder would be stirred up in all directions, and that the valves would leak; and various other things would happen. But, in practice, these difficulties were not found. The motor worked smoothly, and without any perceptible commotion. The consequent working was marvellous for the size of engine he tested; and the economy was also marvellous. If proportionately improved economy was attained from larger units, he thought that even the Diesel engine would have to look to its laurels. Mr. Marshall had complained of the large fly-wheels on gas-engines; but this, as another speaker had pointed out, was due to the fact that they had only one impulse for every four strokes in the Otto engine. But he (Professor Capper) had no doubt, with the development of the two-cylinder and double-acting engines, they would eventually get fly-wheels that would be of the same size as those of the steam-engine for equal power. Several of the speakers had expressed their appreciation of the Atkinson engine; but one of them had said he thought it had too many working parts. Well, personally he disagreed with that opinion. He thought, from the mechanical point of view, as much as from any other, the Atkinson engine was a triumph of ingenuity, and the working parts were by no means as many as in several successful gas-engines. Moreover, the working parts were of large size, and of good mechanical proportions that would avoid the wear and tear which would take place with small working parts. The pump levers and working parts in the two-cycle engine were quite as many, and not of such good form for wear as in the Atkinson engine. The chief reason why the Atkinson engine did not take was that it was too radical for most conservative engineers. English engineers were proverbially rather conservative; and consequently, owing to the novelty of the Atkinson engine design, they regarded it as an engine that would not work. But it did work, and with economical results. Had Mr Atkinson been a more wealthy man, they would have seen the engine developed in a manner that was not in the circumstances possible. Mr. Morewood had asked him the most efficient temperature for the cooling jacket. This was a difficult question to answer; and he (Professor Capper) had failed to find a satisfactory solution. Of course, it varied very much with different cycles. The exhaust gases were released at high temperature; and consequently this meant throwing away a lot of heat in the exhaust. Therefore, other things being equal, there was no particular object in letting the water go away colder than the exhaust. But the difficulty of lubrication came in; and therefore the temperature of the cooling water had to be lowered. He thought that the difficulties came in when the temperature was at anything approaching boiling-point. From 160° to 170° was about the maximum possible temperature, taking lubrication into account. But the whole of this question was swept away where they had an arrangement like that in the Vogt motor. [Some of the other questions asked, Professor Capper had to pass over with the remark that to deal with them adequately would necessitate a complete paper on each.] Regarding the suction producer, this was an interesting development. He had, however, had no practical experience with it, and therefore could not say whether the thousand-and-one difficulties that suggested themselves, in constant work and with large powers, would be actually found in practice or not. But the speakers who alluded to the subject seemed to think the difficulties were not present, or were not great. Of course, the arrangement was an attractive one; and it might possibly have a wide application. On the point of utilizing the waste heat of the engines for producing gas from volatile liquid for a second engine, he referred to this as being a most fascinating idea. But it would produce complication; and engineers rather jibbed at adding anything in the nature of complication. On the whole, he did not think that the proposal—at all events, at the present time—was of intrinsic moment. The gas-engine was passing so rapidly the thermal efficiency of the steam-engine, that he thought it was at present rather a refinement to take out the heat of the cooling water; and there were clearly other questions in connection with gas-engines that were more pressing. As to the gas-turbine, he believed it would come, and not very far hence. Mr. Merritt asked his experience about the Tangye engine. He (Professor Capper) had heard of similar troubles to those related in connection with other engines. Even the Crossley engine had been known to produce miss-fire; and he was not sure there had not been trouble with the governor gear at one time also. Consequently, it was hardly proper for him to reply to the question. Mr. Cutler's remarks were extremely *à propos* and interesting; and he seemed to think there might be a *quid pro quo* for the extra expense involved in the use of lighting gas for motive purposes. He (Professor Capper) was not sure that they might not find that the lighting companies would ere long be producing power gas, and even going to the expense of laying a separate set of mains for it. He did not say it was likely at the present time, but it was a possibility. Personally, he believed the difference in the cost of using lighting and power gas would induce the employment of the latter wherever possible.

Yorkshire Junior Gas Association.—A meeting of this Association will be held next Saturday, at the Bradford Municipal Technical College. Mr. J. F. Smith, of Halifax, has promised to contribute a paper entitled "Notes on Gaseous Firing."

Dellwik Water Gas on the Continent.—A Dellwik water-gas plant of a million cubic feet capacity per day is to be installed at the Mariendorf (Berlin) works of the Imperial Continental Gas Association. In addition to this contract, the Dellwik-Fleischer Water-Gas Syndicate have lately received orders for the supply of plant to Dortmund, Salzwedel, and Stuttgart, as well as for a suburb near Paris.

Scott-Snell Lamps for Whitehall.—The work connected with the installation of the Scott-Snell system in Whitehall is being rapidly proceeded with. In all, fifteen lamps are being fixed. The columns which will carry them are of unusual length; being, we believe, about 17 ft. 9 in. above the ground-level. This is to an extent carrying out the idea of the City Engineer of Westminster (Mr. J. W. Bradley) of having large sources of light on high standards, in order to obtain a really good distribution of the light.

MANCHESTER AND DISTRICT JUNIOR GAS ASSOCIATION.

Visit to the Ashton-under-Lyne Gas-Works.

The members of the above-named Association visited on Saturday the gas-works at Ashton-under-Lyne, which had been thrown open for their inspection by Mr. R. Hooton, the Engineer and Manager. Difficult and delayed railway travelling, owing to fog, somewhat thinned the attendance; but about thirty members put in an appearance, and a very interesting afternoon was spent in going through the works, which have recently undergone considerable alteration and extension, including an installation of inclined retorts and new purifiers.

Mr. Hooton received the party, and, before taking them round the works, said the one great disadvantage they had to contend with at Ashton was that they were cramped for room. The works, which were restricted to an area of about 1¼ acres, and were hemmed in by public streets, were being gradually remodelled, and the total daily capacity, which was now 2,340,000 cubic feet, would be increased to upwards of 4 millions, which he thought would be a remarkable result to attain in works occupying so limited an area. The Ashton Gas Company, he proceeded to say, was a very old one, and was re-incorporated in 1847. At that period, the consumption of gas was only 30 million cubic feet per annum, and the price 4s. 6d. per 1000 cubic feet. At the present time, the consumption per annum was 343 millions, and the price all round 2s. 4d.; the illuminating power at which the gas was usually supplied being 18½ candles, but sometimes higher. There were three retort-houses, of a total capacity, as he had said, of 2,340,000 cubic feet, which worked out at 10,000 cubic feet per ton of coal carbonized. No. 1 retort-house consisted of 14 beds of six, 18 ft. by 24 in. by 16 in., on the direct-fired principle. The ascension-pipes were 6-inch, and 13 feet long, with a 12-inch cross main. They were worked in three sections of one, three, and two twos, with ordinary hydraulics and no tar-boxes. The stokers carbonized 2 tons of coal per shift of eight hours, attended to all fires, and wheeled the coal in and the coke out. The charges were six-hour, and the total capacity of the house per 24 hours was 840,000 cubic feet. No. 2 house had five beds of eight, 20 ft. by 24 in. by 16 in., on the generator principle. The ascension-pipes were 7-inch and 6-inch, and 12 ft. 6 in. long. Weir valves were supplied to each section of the bed, and one tar-box to each side of the bench. These were built on the principle of the late Mr. Chester. They had now been working for six years, and the retorts had only been changed once. The producer, up to the floor-line, had not been touched, with the exception of the sailing courses, of which it was customary to replace each season two 3-inch courses, which were chipped off in the process of cleaning out. This setting, he might mention, had given every satisfaction. The stokers carbonized 68 cwt. of coal per shift of eight hours, and assisted in filling the generator when required. There was one wheeler for coal and coke to two stokers. The charges were 4 hours 48 min.; and the total capacity of the house for 24 hours was 700,000 cubic feet. No. 3 house was on the inclined-retort principle, and consisted of six beds of seven and one bed of eight, 16 in. by 14 in. top and 16 in. by 24 in. bottom, taper retorts, 20 feet long. The ascension-pipes were 8-inch tapering to 7-inch, and there were 8-inch weir-valves to each section. There was an 8-inch take-off pipe to each bed, and one tar-box for the whole seven beds. The hydraulic main was of the ordinary type, and there was an 18-inch foul main throughout the length o the houses. On all hydraulic mains there was, as nearly as possible, a seal of 1½ inches. The charges were six-hour; and the total capacity of the house per 24 hours was 800,000 cubic feet. With regard to the inclined setting, he might state that the cost of repairs worked out to about the same as for the ordinary horizontal regenerative setting. There had been very little trouble with stoppages in the ascension-pipes, which had been in use four years, and the retorts had not been changed. After working practically ten months out of the twelve, he found there was a difference of at least 1s. 3d. per ton less than by working the ordinary horizontal settings. It was true they needed more attention than these; but, on the whole, he had found them most successful with his style of carbonization. The make of gas per ton of coal and the illuminating power were about the same. The condensers were 36 feet high, 3 ft. 6 in. in diameter, with 18-inch connections, and a capacity of 2,500,000 cubic feet per 24 hours. They were of the annular type, and arranged in two sections, so that either could be used separately or the two combined as required. There were two condensers—one by Anderson, with a capacity of 30,000 cubic feet per hour, and the other of R. & J. Dempster's reciprocating type, with a capacity of 60,000 cubic feet per hour. Although the total capacity was thus 90,000 cubic feet, the two condensers combined frequently in the winter worked up to 100,000 cubic feet per hour. The steam-raising power (which, like the exhausters, was at present very much overworked, and would have to be replaced by larger plant) consisted of one very old boiler, 18 ft. 6 in. by 6 ft., working at 60 lbs., and developing 27-horse power, and a second 24 ft. by 6 ft., developing 36-horse power, and both fitted with Meldrum's patent furnaces. A Livesey washer was used as a tar-extractor solely, and had a capacity of 2 million cubic feet per 24 hours. The height of the tar-scrubbers was 70 feet to the machinery-room, and 100 feet to the top of the weather vane; the diameter was 13 ft. 6 in. They were fitted with boards on edge, in the usual style; and their capacity was 3½ million cubic feet. Both were used for ammoniacal liquor. A Kirkham washer was employed for extracting the ammonia—clean water only being used; and it had a capacity of 1¼ million cubic feet. It was, however, about twenty years old, and would have to be dispensed with for a tower scrubber. He had just changed the system of purification, which was carried out in two houses, finishing now through lime instead of oxide. In the first house, the oxide boxes, three in number, were on Green's principle, and were 32 feet long, 28 feet wide, and 6 feet deep, with a capacity per hour of 64,512 cubic feet, and per 24 hours of 1,548,000 cubic feet. The boxes were filled with two layers of oxide, 20 inches thick at the bottom and 18 inches at the top, and were worked by ordinary 18-inch rack-valves. There were three hydraulic valves for the outlets, and they could use either one, two, or three, as required; but it was usual, in the winter, for the three to be at work at once, except when changing. Since the boxes were first used, about eighteen months ago, they had given every satisfaction. The elevators and conveyors had a capacity for refilling the purifiers in six hours—the estimated quantity being 90 tons; but they could be refilled in four hours if requisite. The discharge was by four shoots at the bottom. The second house was fitted with four purifiers on the late principle; the boxes being used solely for lime, and worked by ordinary centre-valve, three on and one off. The length and breadth were 30 feet, the depth was 5 feet, and the capacity 54,000 cubic feet per hour and 1,296,000 cubic feet per day. These boxes were being used with three layers of lime 4 inches thick; and the system of lifting the covers was by two goliaths. This was a very easy method, as two men were quite sufficient to raise and travel the cover over to the other box. The connections throughout were 18-inch. Owing to the restricted area of the works, the station meters (of which there were two—one by Braddock, and the other by the Gas Meter Company—each with a capacity of 40,000 cubic feet per hour) had to be placed at an unusual distance from the purifiers, and were, in fact, in a special building outside the works. Adjoining the meter-house they had two holders, each of 300,000 cubic feet capacity; and about three-quarters of a mile from the works they had, near Guide Bridge, two other holders, each with a capacity of 1 million cubic feet. There were three governors—one on the bell principle, with 14-inch connections; another of the ordinary type, worked by weights, with 16-inch connections; and the third one of Braddock's latest beam governors, with 24-inch connections. This governor had a water-supply apparatus which worked automatically, increasing and decreasing the pressure according to the demand in the case of sudden fog or darkness; and it had been found very satisfactory. The total length of mains, ranging from 2-inch to 24-inch, was about 47 miles. Although the district was fairly level, it was extensively undermined; and as the pipes were in many cases very old, the leakage was in excess of what it otherwise should be—averaging 8 to 9 per cent. They supplied 11,000 houses and shops, 120 mills and workshops, upwards of 100 gas-engines, about 5000 cookers, and 1000 slot-meters.

A complete inspection of the works having been made, the members returned to the offices, where light refreshments had been provided by Mr. Hooton. Before separating,

The PRESIDENT (Mr. W. Hill), after remarking that he was sure they had all been very much interested in what they had seen, called upon

Mr. J. ALSOP (Stockport), who proposed a vote of thanks to Mr. Hooton, not only for the permission given to visit his works, but for the hospitality he had shown. The members had seen what could be accomplished in a very circumscribed area, and how extensions had to be planned in a careful and methodical manner. Mr. Hooton had afforded them a vast amount of most valuable information, and they were greatly indebted to him for his kindness.

Mr. J. E. DUDLEY (Higginshaw) briefly seconded the proposal, which was most heartily adopted.

Mr. HOOTON, in response, said he had been very pleased to receive the Association. No doubt they were all aspiring to be gas managers or engineers; and what he would advise them was to become experts in some particular branch of their profession, and to make electrical engineering a part of their study, as they would constantly find matters cropping up where electrical knowledge would be specially useful. He would also advise them never to miss an opportunity of visiting works, however small or large they might be, because they would always be able to gather useful information. He hoped, in the course of a couple of years or so, to invite them to again visit his works, when he would be able to show them something really worth seeing.

The Millennium Light.—The publication of Dr. Drehschmidt's paper and diagrams in this week's issue may give rise to inquiries; and, in order to save correspondence, it may be stated that the address of the International Compressed Gas Syndicate, Limited (who control the world's patents for the light), is at No. 57, Barbican, E.C.

SOUTH-EAST OF IRELAND GAS ASSOCIATION.

The Fifth Meeting of the Association was held at the Waterford Gas-Works on Friday, the 27th ult.—Mr. R. BRUCE ANDERSON (the President) in the chair.

The HON. SECRETARY (Mr. G. Lennon, of Dungarvan) reported the loss of two members through death and resignation, while three new ones had been elected; making the membership 13. He also reported a balance of £2 5s. to be carried forward, out of a total income of £3 10s. The following were appointed office-bearers for the ensuing year:—

President.—Mr. J. Paterson, of Queenstown.
Vice-President.—Mr. J. Richmond, of Kilkenny.
Hon. Secretary and Treasurer.—Mr. G. Lennon, of Dungarvan.
Auditor.—Mr. J. G. Tooms, of Waterford.
Member of Committee.—Mr. G. W. Norman, of Dublin.

Mr. F. J. TYNDALL (Mallow) then read a paper on "Incandescent Street Lighting." He said he had devoted particular attention to this matter in England, and also since coming to Ireland, at Waterford, Carrick-on-Suir, and Mallow, during the past six years. After having had experience of various patterns and sizes of lanterns, burners, anti-vibratory appliances, &c., for ordinary purposes, where the cost of installation and of subsequent maintenance had to be kept as low as possible (which was the case in most small towns, and in the less important portions of the big ones), he had come to the conclusion that a large—say, 16-inch—lantern, fully glazed at the bottom, protected from wind by gauze at the top, furnished with a "C" burner and normal chimney, hung from an A.V.I.L. attachment, was the most satisfactory outfit to adopt. For lighting, he advocated a "Rocket." He gave cogent reasons and figures for his decision as to illumination, consumption, labour, and the durability of mantles.

The paper gave rise to a long and animated discussion, in which (in accordance with the exceptional rule pertaining to the Association) every member present took part.

Mr. LENNON favoured "C" burners in preference to Kerns.

Mr. TOOMS expressed a decided preference for Kern burners as being much more satisfactory at low pressures such as were employed during the small hours of the morning. He advocated, where possible, having a man to attend to the lights with a more gentle hand than the stoker, who in small works was generally expected to look after the lamps. He questioned the necessity for anti-vibratory devices, save in exceptional cases, now that mantles were so cheap. He favoured frequent renewals, as, when cleaning burners, considerable time was lost in saving an old mantle, which, after all, was old, and not so satisfactory as a new one.

Mr. J. RICHMOND (Kilkenny) expressed a preference for "C" burners, and considered a 14-inch lantern was amply large; the damage done to mantles in cleaning being, to his mind, a question more of the individual employed than the dimensions of the lantern. He strongly advocated A.V.I.L. attachments, but said it was necessary to watch for leakage from the rubber.

Mr. DUNN (Carrick-on-Suir), from his experience with the A.V.I.L. attachment, confirmed Mr. Tyndall's appreciation of it, but questioned whether its cost would be saved in mantles. In Carrick, he had No. 2 Kerns, with Bohr reflector, in old 14-inch lanterns, side by side with No. 4 Kerns in new Welsbach lanterns, and half-way between them it was difficult to decide which gave the better effect.

Mr. D. W. TOOMS (Fermoy) found no difficulty in cleaning his old 14-inch lanterns with the bulb inside. He considered a No. 2 Kern less powerful than a "C," but more efficient. In small country towns, where there was so little vibration, he thought the A.V.I.L. device superfluous. He advocated the bulb lamp, if old lanterns had to be used, as having, so to speak, a lantern within a lantern made the whole wind-proof. In support of this, he stated that the two dozen bulb incandescents which he had when in Mallow all remained alight throughout a gale last February, when practically the whole of the remaining 60 flat-flames in similar lanterns were blown out.

Mr. J. GRANT (Tipperary) drew attention to the practice in many places of the town officials attending (?) to the cleaning and maintenance of the lamps, and said that from his experience of both systems, he strongly advocated this work being done by the gas company.

Mr. KIRKHAM (Tramore) preferred Kern to "C" burners, as, though more difficult to clean, he found they did not require to be cleaned so frequently.

Mr. WINPENNY (Waterford) gave some particulars of the satisfactory and economical lighting of Victoria Square, Middlesbrough, with 30 "C" burners in a very exposed position.

Mr. JONAS (Waterford) submitted that, from his observation of the lighting in Liverpool, where he lived for some years, the long life of the mantles which had been referred to was due to other reasons than the anti-vibration device used. He strongly advocated having lanterns suspended. He pointed out that a better fit was generally obtainable with Kern burner mantles than with those for "C" burners.

Mr. G. W. NORMAN (Dublin) said that rubber anti-vibratory devices had not proved satisfactory in Dublin. He described Mr. Cotton's hydraulic seal and spring anti-vibrator and electric ignition,* which is in operation in Kingstown.

The PRESIDENT summed up the discussion. He said he considered anti-vibrators advisable only in positions subject to serious vibration, and there they should be systematically examined for leakage, which in a lamp 10 feet above ground might easily escape discovery. In selecting No. 2 Kern burners in bulbs with Bohr reflectors for use in several towns, he was influenced by two considerations. He wanted a cheap outfit which would work satisfactorily without scrapping the old lanterns, burning a small quantity of gas, while affording a superior light, so that at no extra charge he could substitute it for the old 4-feet flat-flame burners in vogue. He also chose the Bohr reflector because, being close down on the mantle, it acted much more effectually than opal reflectors placed in any and every position but the correct one in the tops of lanterns, where they served only to cast the light down just immediately around the base of the lamp, instead of spreading it generally over the ground. Before the Kern burners were obtainable, he had used the old "S" and "Gem" burners in bulbs, with metal chimney reflectors; and though they were an improvement upon the 4-feet flat-flames, they were distinctly inferior to No. 2 Kerns, notwithstanding what had been said by a previous speaker as to the comparative value of these and "Gems."

Mr. TYNDALL replied to the various criticisms, and refuted them very forcibly.

The discussion having occupied the full time available for the sitting, it was decided to defer until the next meeting the reading of a paper by Mr. J. G. Tooms on "Carbonization."

A vote of thanks was passed to the retiring President; and the meeting adjourned.

STREET LIGHTING IN BERLIN: A COMPARISON BETWEEN ELECTRIC ARC LIGHTS AND HIGH-PRESSURE GAS-BURNERS.

Some Results of Photometrical Observations conducted by Professor Drehschmidt.

[Translation of a Paper Read before the German Association of Gas and Water Engineers. The Diagrams referred to are published as a Plate with this issue of the Journal.]

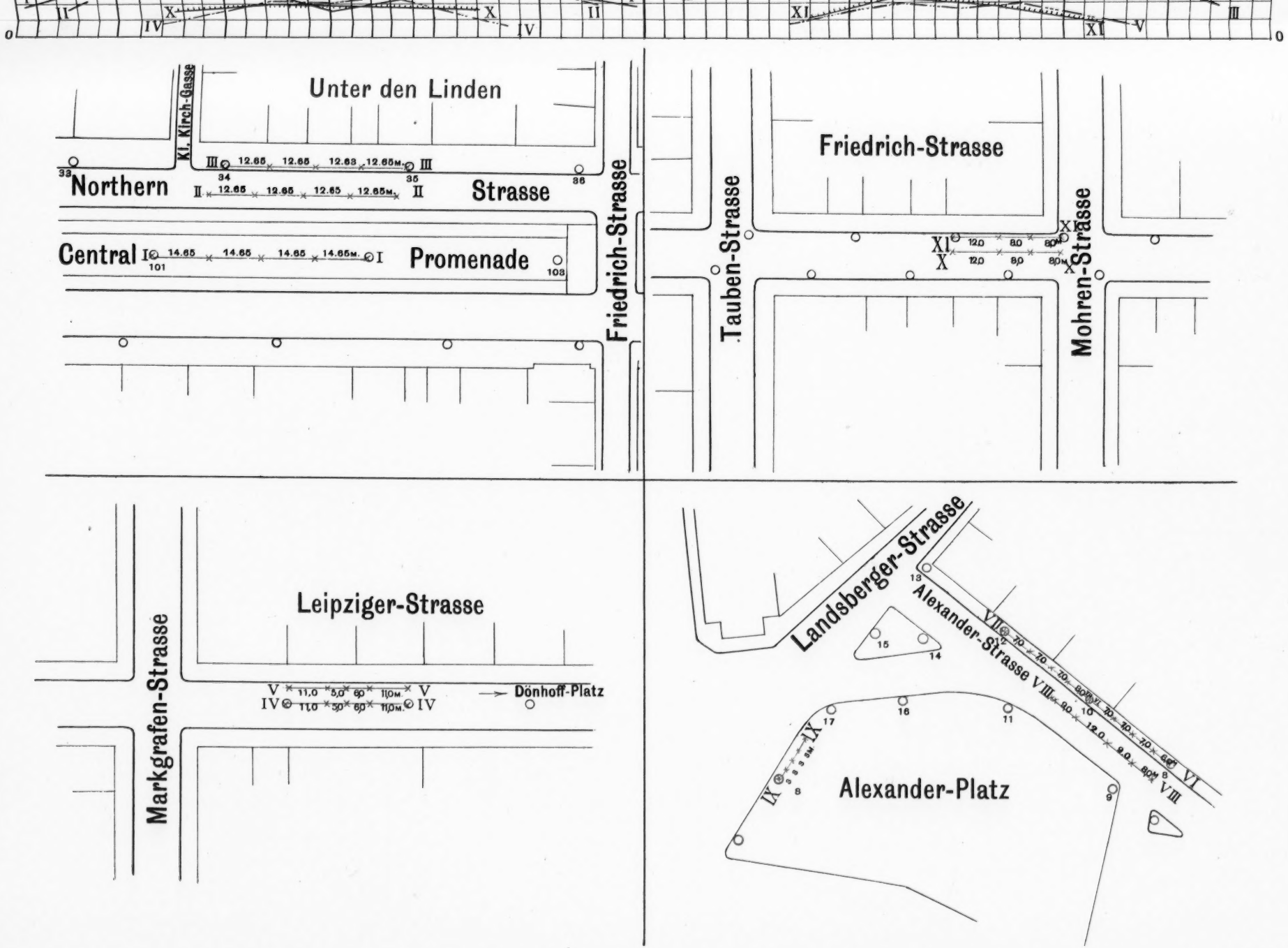
At the General Meeting in Düsseldorf of the German Association of Gas and Water Engineers, I read a paper upon the experiments made in Berlin for the purpose of obtaining, by means of high-pressure incandescent gas-burners, as powerful a means of street lighting as the electric arc light. These experiments have been continued over a number of years.

A beginning was made with Lucas lamps, which were placed in the Friedrichstrasse between the Taubenstrasse and Leipzigerstrasse. The photometrical survey of that place, and a comparison with the light produced in the Leipzigerstrasse by 15-ampère arc lights, showed that, while in some parts of the Leipzigerstrasse the light was better than that in the Friedrichstrasse, on the whole the lighting by incandescent gas was not inferior to the electric light.

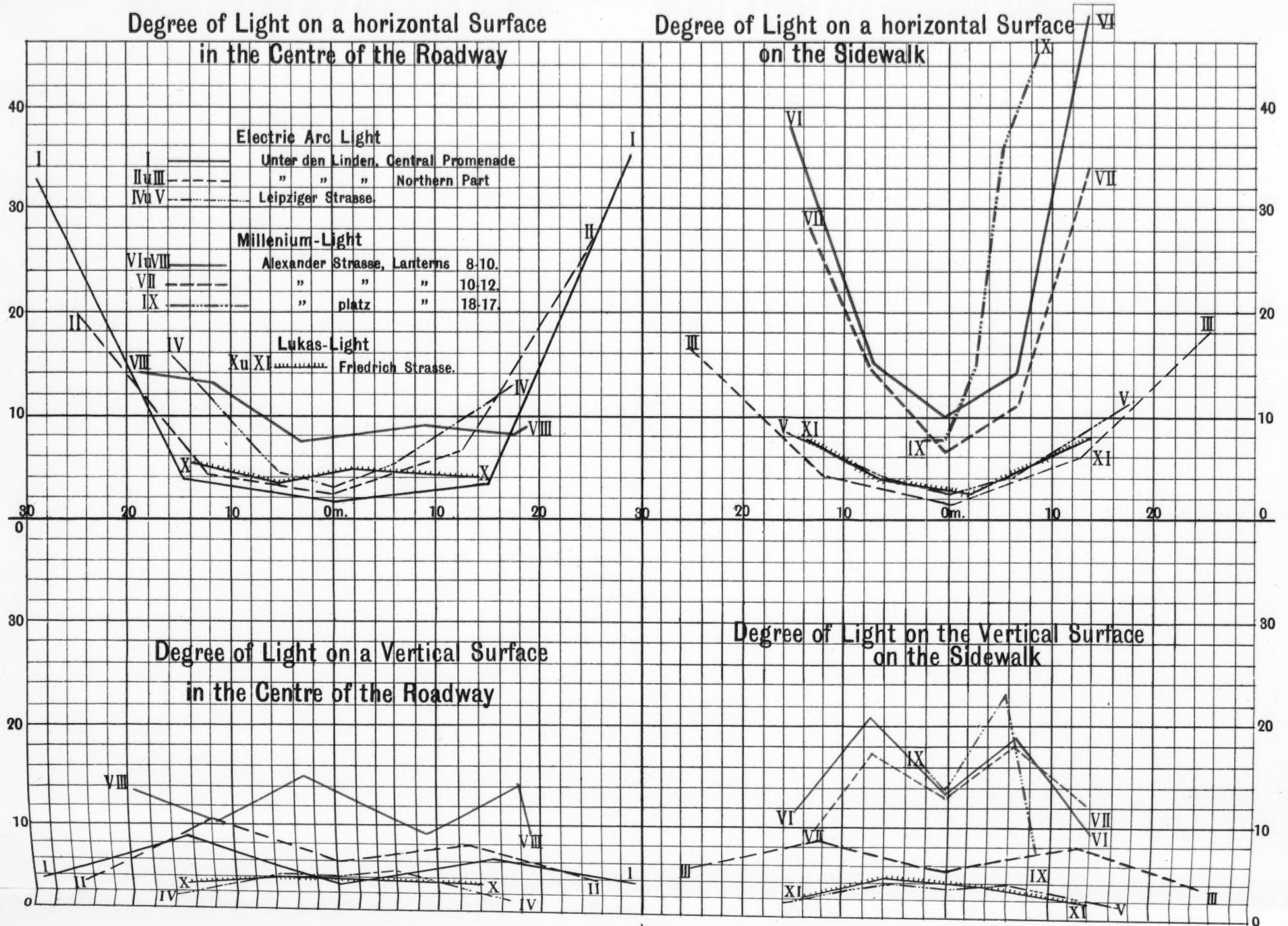
The light in the streets is, however, greatly influenced by the very brilliant lighting of the shop windows and entrances to the many business establishments and restaurants in the Friedrichstrasse and Leipzigerstrasse. The result of the photometrical observations, which were made after midnight, in order to be independent of these influences, was, therefore, very often contradictory to the opinion of laymen. The latter generally look at the light sources, and allow themselves to be influenced by their brilliancy in judging the light prevailing upon the street itself. In the Friedrichstrasse, there were, in a distance of the same length as in the Leipzigerstrasse, more Lucas lamps than there were electric arc lights in the latter. But the arc lights possessed a higher candle power and greater brilliancy than the Lucas lamps; and people who looked rather at the lamps than at the objects in the streets might well be excused for believing that the light in the Leipzigerstrasse was considerably greater and better than that in the Friedrichstrasse.

The lighting of the Friedrichstrasse not being quite equal to that of the Leipzigerstrasse, and also in view of the fact that public opinion has always to be reckoned with, even if it be mistaken, the experiments to create, by means of incandescent gas, light sources as powerful as those obtained from the electric arc light were strenuously continued. The results of these experiments were so far favourable that we succeeded in raising, by means of the Millennium apparatus and compressed gas, the power of a single incandescent gas-burner to the so far unattained height of 1500 and even 1800 Hefner candles. The burners of 1500-candle power and 1200 litre gas consumption per hour were used for lighting the Alexander Platz, and that part of the Alexanderstrasse which abuts on it. Each of the lamps placed there contains two burners of 1500 Hefner candles each. Here, too, photometric observations were made for the purpose of determining

* See "JOURNAL" for Sept. 1, p. 570.



Berlin by Electric Arc Light and by Incandescent Gas Light-High Pressure Burners.


Degree of Light on a horizontal Surface in the Centre of the Roadway
Degree of Light on a horizontal Surface on the Sidewalk
Electric Arc Light
I Unter den Linden, Central Promenade
II u III " " " Northern Part
IV u V Leipziger Strasse.
Millenium-Light
VI u VIII Alexander Strasse, Lanterns 8-10.
VII " " " 10-12.
IX " platz " 18-17.
Lukas-Light
X u XI Friedrich Strasse.
Degree of Light on a Vertical Surface in the Centre of the Roadway
Degree of Light on the Vertical Surface on the Sidewalk
40
30
20
10
0
30
20
10
0m.
10
20
30

the degree of light prevailing in the street, and to compare it with the electric light. These comparative observations were recently continued in the Unter den Linden, where the former lighting by 15 ampère arc lights had been improved by the substitution of 17 ampère arc lights.

A scientific determination of the degree of light obtained in the street was so much the more necessary, as lay observers, who merely rely on the impression made upon them by general appearances, are easily deceived by contributory circumstances. If, for instance, the particular place under observation is bounded by houses, the impression will be quite different from what it would be if the place were open. Other methods for determining the degree of light might have been adopted; but scientific photometric survey appeared to be the best and safest plan.

The observations were only taken when no moon was shining in the hours after midnight, because at that time the street traffic did not interfere with the observations, while, on the other hand, the lights in the shops and restaurants did not exercise any influence worth mentioning on the results. The degree of light was measured on an opaque milk glass sheet placed about 5 ft. 6 in. above the street pavement—horizontally and also vertically. When horizontally measured, the degree of light indicates the clearness with which objects on the pavement itself may be seen. Of much greater importance, however, is the degree of light on the vertical surface, because it is the criterion for the clearness and distinctness with which persons and objects approaching towards the observer may be recognized.

The instrument used for taking the observations was the street photometer constructed by the Imperial Physical-Technical Institute. This instrument has a certain similarity with the Weber photometer. I have made a few alterations in its construction, in order to be better enabled to measure also the degree of light indicated on the already mentioned sheet of milk glass. This sheet of milk glass I placed upon the moveable tube. According to the horizontal or vertical position which is given to the tube, the degree of light on the horizontal or vertical surface may be measured. The vertical surface receives the light first on one, and then on the other side. The quantity of light at any given point in the street differs according to whether the surface is turned to the nearer or to the farther light source. In comparing the degrees of light, as they were obtained in the streets through arc light or through incandescent gas-light, the average of the degrees of light observed in both directions has been adopted as the standard.

In my paper last year, I mentioned the result of my observations in only a few words. [A summary translation of the paper here referred to appeared in the "JOURNAL" for Feb. 3 last, p. 288.] In the subjoined table, they are shown together with those recently obtained in the Unter den Linden. I have added diagrams illustrating the distances of the several points of observations from each other and from the light sources or lamps. In the Friedrichstrasse and Alexander Platz, the lamps are fixed on the side path or close to it; while in the Leipzigerstrasse the arc lights are suspended above the centre of the roadway. In the Unter den Linden, the traffic roads proper are lighted by lamps on the side path, while the central promenade is lighted by lamps suspended above the centre. The measurements were taken at several positions on lines between the several lamps on the corresponding points in the centre of the roadway and on the side path or close to it. In the Friedrichstrasse, the two lines of measurement were about 5·5 m. distant from each other; in the Leipzigerstrasse, about 5·6 m.; in the Alexanderstrasse, from 7 m. to 7·5 m.; and in the northern part of Unter den Linden, 7 m. It will thus be seen that the general lighting conditions under which the measurements were taken, were more favourable in the Leipzigerstrasse and Friedrichstrasse than in the other streets.

In order to make the results which were obtained more easily understood, they are shown in the diagram. From the centre between the lamps on the corresponding points, the degrees of light prevailing at the places on the right and left sides of the points in question are indicated in "Lux" (according to the meter-candle method formerly in use). From the diagrams, it is easily observable that lines X. and XI., indicating the horizontal degree of light with Lucas lamps, are much more even than lines IV. and V., indicating the electric light in the Leipzigerstrasse, with which the Lucas lamps were to compete. In the neighbourhood of the electric arc lights, or close underneath them, on the roadway the degree of light (15·9 and 12·3 Lux, line IV.) is considerably greater than on the corresponding points in the Friedrichstrasse (5·2 and 4 Lux, line X.); but it declines strongly and quickly towards the centre between the lamps where it is considerably lower than in the Friedrichstrasse. On the sidewalks of both streets, however, the degrees of light obtained are almost equal (lines V. and XI.). The degrees of light on the vertical surfaces are in both streets nearly equal—nay, in the roadway of the Leipzigerstrasse it is even in some places considerably lower than in the Friedrichstrasse (lines IV. and X.). The many attempts which have been made to belittle the Lucas light are, therefore, but little justified.

The Millennium light in the Alexanderstrasse, however, is far superior to the electric light of the Leipzigerstrasse, as is conclusively proved by a glance at the diagram. The degrees of light of the horizontal surfaces in the centres of the roadways in the neighbourhood of the lamps are not so very different—viz., in Leipzigerstrasse 15·9 and 12·3 Lux (line IV.); and in Alexander-

—	Line along which Observations were Taken	Distance between Lamps.	Horizontal Surface.		Vertical Surface.					
					Central Roadway.			Sidewalk.		
			Roadway.	Sidewalk.	Right.	Left.	Centre.	Right.	Left.	Centre.
Friedrichstrasse, Lucas Lamps.	Str. X	29	5·15	7·64	3·44	3·16	3·30	2·68	1·29	1·98
	B. XI	..	3·44	3·77	4·53	3·75	4·14	3·02	5·44	4·23
	..	..	4·61	2·33	3·16	3·91	3·78	4·21	2·85	3·53
	..	..	4·60	8·21	3·25	2·74	3·00	1·75	1·62	1·69
Leipzigerstrasse, Electric Arc Lights	Str. IV	33	15·86	8·27	1·25	2·05	1·63	1·14	2·28	1·71
	B. V	..	4·13	3·64	5·51	3·18	4·34	4·96	3·00	3·98
	..	..	2·96	2·37	3·47	4·39	3·93	2·88	3·67	3·28
	..	..	5·02	3·94	2·28	6·81	4·54	2·02	5·08	3·55
	..	..	12·32	10·70	1·34	1·60	1·47	1·52	1·64	1·58
Millennium, Alexanderstrasse.	Str. VIII	..	14·80	38·20	..	13·80	13·80	10·90	11·20	11·10
	B. VI	VI	13·00	14·50	11·60	8·20	9·90	18·00	22·60	20·30
	u. VII	28	7·50	9·60	17·90	11·60	14·80	11·30	13·50	12·40
	..	VII	8·90	13·50	8·10	10·00	9·00	28·20	7·90	18·10
	..	31	8·00	49·00	13·60	13·90	13·80	9·50	7·60	8·60
	..	..	8·40	28·30	8·10	10·20	9·20	8·20	9·30	8·80
	..	..	..	13·70	..	..	..	7·20	26·10	16·70
	..	..	..	5·70	..	..	..	10·10	13·50	11·80
	..	..	..	10·40	..	..	..	25·60	9·30	17·40
	..	..	..	33·80	..	..	..	14·60	7·60	11·10
Alexander Platz.	B. IX	23	..	7·50	..	..	..	16·20	16.90	16·60
	..	..	..	7·20	..	.	..	10·70	18·80	14·70
	..	..	..	13·80	..	..	..	8·00	27·40	17·70
	..	..	..	35·40	..	..	..	6·30	38·10	22·20
	..	..	..	44 80	..	..	..	5·00	6·90	6·00
Unter den Linden, Electric Arc Light, Northern Street.	Str. II	50	20·10	16·30	2·60	4·20	3·40	7·40	3·30	5·40
	B. III	..	4 20	4·30	14·20	6·80	10·50	13·20	3·80	8·50
	..	..	2·30	1·50	4·30	7·30	5·80	4·30	6·40	5·40
	..	..	6·60	6·10	2·10	14·00	8·10	2·50	13·60	8·00
	..	..	26·80	17·80	2·80	4·50	3·70	3·70	3·30	3·50
Central Promenade.	I	59	33·10	..	2·90	4·50	3·70	..	..	..
	..	..	3·90	..	4·20	13·00	8·60	..	..	..
	..	..	1·60	..	3·90	4·50	4·20	..	..	..
	..	..	3·30	..	9·20	3·20	6·20	..	..	..
	..	..	35·10	..	2·20	4·80	3·50	..	..	..

strasse, 14·8 and 8·4 Lux (line X.). The decline to 8·4 Lux on the one point has its reason in the unfavourable position. Midway between the lamps, however, on the roadway, the degree of light in the Leipzigerstrasse is more than 50 per cent. lower than in the Alexanderstrasse (about 3 Lux as against 8 Lux).

On the side walk of the Alexanderstrasse, the degree of light on the horizontal surface is everywhere considerably higher than in the Leipzigerstrasse, both near the lamps (about 28, 38, 45, 49, and 34 Lux, lines VI., VII., and IX., as against 18·5 and 11 Lux. line V), and midway between them (10·7 and 6 Lux, as against 2·5 Lux).

The degree of light on the vertical surface is, as mentioned above, of still greater importance. In this respect, the Millennium light is everywhere much superior to the electric arc light—in the centre of the roadway, as well as on the side-walks. On the roadway of the Alexanderstrasse, the maximum light is 15 Lux, and the minimum 9 Lux; while in the Leipzigerstrasse the corresponding figures are 5 Lux and 1·5 Lux. Greater still are the differences on the side-walks. In the Alexanderstrasse, the maximum degrees of the single measurement lines stand at 20, 17, and 22 Lux (lines VI., VII. and IX.); while in the Leipzigerstrasse they stand at 4 Lux (line V.). The minimum figures are in the former street 9·9 and 7 Lux, and in the latter 1·5 Lux.

The comparison between the lighting of the Alexander Platz and the Unter den Linden results in similar proportions. As in the Leipzigerstrasse, it is only on the horizontal surface in the centre of the roadway close to the lamps that the degree of light in the Unter den Linden is higher than in the Alexander Platz; everywhere else, but particularly midway between the lamps, it is considerably lower—the minimum being 2 Lux (lines I. and II.) as against 7·5 Lux in the Alexander Platz. On the side-walks the degree of light on the horizontal surface is everywhere considerably higher than in the Unter den Linden. The degree of light on the vertical surface is, on the roadway as well as on the side walks of the Alexander Platz—in the maximum as well as in the minimum figures—two and even three times higher than in the Unter den Linden, and that notwithstanding the increase of lighting power in the latter street from 15 to 17 ampères.

The above-stated observation conclusively proves that it is by no means impossible to produce, by means of high-pressure incandescent gas-burners, a light which is well able to compete with the electric arc light. Besides, the high-pressure incandescent gas-light has a warmer and more beautiful colour and is more agreeable to the eye than the electric arc light.

SOME FEATURES OF MUNICIPAL OWNERSHIP.

By Henry L. Doherty, of New York.

[Extracts from a Paper read before the American Gaslight Association.]

The agitation for municipal ownership is largely a fad, but one which is injurious both to public and privately owned municipal utilities. It is a handicap on the legitimate development of utilities which is frequently responsible for inadequate service from a geographic standpoint, and poor and uneconomical service where it does exist. Some of the men who pose as the "friends of the people" in advocating municipal ownership are often sincere, though other advocates are prompted by the same motives which actuate the spider to invite the fly to his web. And yet it never seems to occur to these men that, in continually threatening private enterprises with municipal opposition, they are curtailing the credit of private business—rendering it impossible for it to secure funds on a sufficiently advantageous basis to enable it to give good and adequate service and to provide new and modern equipment which will enable it to supply service at lowest cost. This continual threat of municipal opposition has already discredited private undertakings to an extent which probably prevents many small communities from enjoying the benefit of gas and electric light plants, though able to support such enterprises. Take away this threat, and gas and electric securities will have the same value they now have at an interest rate one-third less. The politician has nothing to lose from this agitation, but the public and you, gentlemen, have. The burden of demonstrating the actual degree of success or failure of municipal ownership must, therefore, rest with you. It is a question which can be permanently disposed of by honest and determined treatment. We must give municipal ownership credit for such advantages as it enjoys, and we must not only be willing to show the shortcomings of private ownership and corporation misconduct, but we must help to expose these shortcomings, correct misconduct, and seek means for improvement.

If we are going to give municipal ownership thorough consideration, we must start from fundamental facts and consider questions of an elementary character. An element of the principles of Radical Socialism always influences the consideration of this problem; and therefore we must assume, for the sake of a point from which to start, that it is both impossible and inequitable. It is an irrational plan for the division of the fruits of labour regardless of worth and merit. The opportunity for the co-operation of capital and labour through lawful incorporation not only offers a means for the equitable division of the fruits of labour, but renders possible the realization of the benefits of economic laws, which adds to the productiveness of labour, capital, and thought to a sensational degree. What we want is further co-operation rather than the destruction of that which we already have. Politicians are striving to divide the public into one class which invests and another class which works. After this division has been secured, the politician and the demagogue can easily work up class prejudice—in fact, he has already done so. The future of American supremacy depends, first, upon checking this class division, and next upon the amalgamation of the classes. A large element of the investing class is already composed of the hardest workers in the world. It only remains for more of the working class to be investors, and for the organizers of incorporated companies to issue securities in such small amounts as to be available for sums of money no larger than fair-sized individual savings-bank deposits, and for the co-operation of those having influence with the members of the working class to induce them to become investors.

Municipal ownership is advocated largely on the grounds of universal co-operation. At first glance, it "looks good." But after careful study, it will be found not to be expedient, rational, equitable, or desirable; while co-operation by legalized incorporation offers a rational, equitable, and desirable system, especially if it can be rendered more available to all classes. If this dream could be realized, incorporation would become a means of almost universal co-operation and a savings bank for the masses.

We are now ready to regard the wisdom and effect of a city acquiring control of public service properties. The scheme finds considerable advocacy, and if there is any reason why a city should embark upon a business enterprise, such reason should not be in discord with wisdom. There also should be a satisfactory reason for selecting the particular class of business enterprise upon which to embark. These questions have been asked of many municipal ownership advocates; but the answers have been too scattering, vague, or illogical for any concrete impression to be obtained. As no uniformity of opinion seems to exist on this side of the question, I will consider all the reasons which have been offered to justify municipal ownership. They are as follows: (1) To render impossible the ownership of a public utility by non-residents. (2) To enable the plant to be operated for the greatest good to the greatest number. (3) To protect the public from fraud. (4) To break up monopolies. (5) To prevent the use of public thoroughfares for private gain. (6) To yield a profit. (7) To cheapen the cost to users. (8) To ensure good service. (9) To ensure equitable division of profits from municipal utilities in the interests of all citizens. (10) To ensure protection of employees of all public utility companies. (11) To enable the city to have employment patronage that it can distribute among the needy. (12) To prevent desirable positions being given to men imported from other cities. (13) To protect municipal officers from temptation. (14) To purify politics, raise the standard of municipal officers, and secure honest administration of all public trusts. (15) To compel citizens to take an interest in public affairs. (16) To assist in raising the standard of living among the poorer classes by supplying them with public service at operating cost. (17) To secure ownership by the people for the elevating effect of citizenship.

It is unnecessary to express opinions of these reasons, for they must be measured by an exact standard. When the framers of the American Constitution used the phrase, "The greatest good to the greatest number," they probably thought it unnecessary to qualify the statement so that it should not crucify the fundamental law of justice. But modern advocates of municipal ownership often interpret this phrase to read, "The greatest good to the greatest number, regardless of justice." For the preservation of the American people, their motto and watchword must be "Justice." Any policy inconsistent with it must be rejected. Their purpose and their reasons, therefore, should permit, first, that justice must prevail; secondly, that truth and experience should not be disregarded; and, thirdly, that matters of opinion should appeal to common sense.

I will take up their reasons and measure them by the standards outlined above: (1) This reason is not always in accord with the third condition—viz., "common sense." When *quasi*-public utilities are sold by local investors, the money is generally re-invested at home. (2) This would not always accord with justice. Examples can sometimes be made most impressive by exaggeration. Let us assume that a city has one taxpayer and 1000 light-users. Acting upon the reason given, some people would advocate supporting the lighting plant entirely by means of taxation, and furnishing light to the citizens without cost. This is simply an exaggeration of the condition which generally prevails under municipal ownership. Service is furnished at less than real cost, and the taxpayers make up the deficit. (3) This reason does not meet either the second or the third condition—"truth" or "common sense." Fraud is impossible without collusion between the manager and many of his employees. (4) This reason does not meet the second condition. You do not break up a monopoly by municipal ownership; you simply change its nature, and render the monopoly feature absolute. (5) This does not meet either the first or the third condition. The use of the public thoroughfares is exactly what they are for; and if it is forbidden to one, it should be to all.

Reasons Nos. 6 and 7 are almost synonymous, and they bring up the real bone of contention. At first glance, it looks as though

the city could at least save the profit of private ownership; and, without further thought or investigation, the average man assumes that the city could either make a profit at the same price or sell at a much less price if no profit were exacted. But the wrecks strewn along the path of municipal ownership history disprove this; and if they were known to the average hard-headed and practical American citizen, they would offer evidence of a more conclusive character than the flowery word-pictures of the man who habitually talks, but seldom works, or the polished rhetoric of the student of economics who has so diligently studied books that he has had no time or inclination to study men. The problem which therefore presents itself is the question of the relative economy of operation under municipal and private ownership. The city has the one advantage of a larger credit, which generally permits it to borrow funds at a lower rate of interest. Beyond this apparent advantage, it has no other worth mentioning; while the private corporation has unlimited advantages of every other character. The margin of difference between profitable and unprofitable management is not so wide but that even one of innumerable elements, which to the inexperienced may seem of relatively small importance, is easily sufficient to cause a profitable private undertaking to become an unprofitable municipal undertaking. Municipal ownership not only offers an opportunity for this mismanagement, but positively invites it; or, to be even more exact, compels mismanagement. The city's advantage in obtaining money at a lower rate of interest is more apparent than real. The lower rate is largely due to the wider margin of difference between the total bonded indebtedness and the property which secures this indebtedness; and as this margin of difference is trespassed upon, the interest rate goes up, not only on the bonds issued for the purchase of public utilities, but also on all other city bonds. It does not require a very heavy advance in the interest rate on all the city's bonds to wipe out all possible advantage on this score, and cause the city many thousands of dollars' loss, all to satisfy a craving to embark upon a business enterprise. Does any reasonable human being believe there can be the same interest and loyalty on the part of the operators of a municipal undertaking that exist on the part of the operators of a private undertaking? No matter how sincere any one or more of the operators may be, the general average must of necessity be much lower. [Mr. Doherty emphasized this point by citing the general bearing of the officials and employees.] The ability of a city to operate a public utility plant at a profit, at the rates charged by private plants, is extremely doubtful; or, stated in a slightly different way, it has not been proved that a municipally-owned plant can furnish service any cheaper than can a private plant. Admitting, for the sake of argument, that the claims of the advocates of municipal ownership regarding the alleged successful plants are true, the fact still remains that for every success which they claim, at least two demonstrated failures can be cited. Neither of the reasons under consideration, therefore, meets the second condition, "Truth."

With regard to No. 8, probably none of the reasons cited are quite so much out of accord with the second condition as this.

Coming to No. 9—"to ensure equitable division of profits from municipal utilities in the interest of all citizens"—this is another pretty dream, born only of sentiment, which needs but slight analysis to dissipate. The taxpayer is compelled to take the risk of the success of the plant; and many of the citizens, and perhaps a majority of them, assume no responsibility for the risk. In many cities, we have the absurd condition which permits a city to embark upon a business proposition if supported by a popular vote of the citizens. One can easily imagine a condition whereby a majority of non-taxpaying citizens would, against the wish of the taxpaying citizens, authorize the city officials to enter upon a business necessitating the creation of debt, for the satisfaction of which the property of the taxpaying and non-consenting citizens would be pledged. It is also easy to imagine a condition whereby a number of small taxpayers and large light-consuming citizens would outvote nearly an equal number of large taxpaying citizens. This condition is inequitable and unjust; and to admit the fact that inequity to this degree is just, is sufficient warrant for the logical conclusion that direct confiscation of property is not unjust. To restrict the vote to the taxpayers only would offer greater equity. But all taxpayers are not voters; and while each voter is given an equal voice, the risk is not equally divided, but depends upon the tax division. No matter what conditions prevail, justice does not warrant a majority in pledging the property of a non-consenting individual to a risk which will not benefit him, but which will in all probability harm him. If the plant proved to be profitable, it probably would be due to the fact that the light consumer was overcharged; and you then have the condition of the light consumers contributing unequally for the benefit of others. Assume the plant is mismanaged and requires the collection of an excessive amount from the consumer, What means has he for redress? Prate about breaking up monopolies if you will; but, under these conditions, municipal ownership becomes the most pronounced, oppressive, and odious monopoly that could well be imagined—a monopoly placed in the hands of politicians, a class of people commonly designated by the Press of America as incompetent and insincere.

With regard to the remaining reasons, they are attempts to inject into public service philanthropy and conditions contrary to economy. Municipal ownership is to be made an institution of charity, and the needy are to be determined by their political faith. Citizens are to be compelled to neglect their own business to spy upon the conduct of municipal officers, or be robbed as punishment for their neglect of this unwillingly contracted public duty. Municipal ownership is to raise the standard of living, and our mechanics shall become poets, painters, and students of books on sociological subjects by authors whose arguments are created to bolster up previously expressed views born of prejudice and lack of knowledge. Sarcasm and satire are seldom effective weapons; but when logic is spurned, truth rejected, and reason assassinated, no other effective means of protest are offered.

To sum up, the reasons advocated for municipal ownership may be classed under three heads, which, stated in the order of their importance, are: (1) Economic, (2) philanthropic, (3) sentimental. The economic reasons are in general not well founded, are scarcely ever in accord with truth, and are at great variance with experience. The advocates assume they can operate a public service plant with economy equal to or greater than can private enterprise. This has not been proved true, or at least has not in the majority of cases where municipal ownership has been tried. If municipal ownership is to be urged for philanthropic reasons, almost any other form of business enterprise which a city might choose to embark upon would offer greater opportunity to benefit the citizens than does the operation of public utility plants. From a sentimental standpoint, the arguments advanced in favour of municipal ownership are generally prompted by prejudice, which to a large extent is entirely unwarranted. They are so pronouncedly in discord with justice as to be repugnant to every fair-minded man, after careful consideration.

Mr. Doherty then went on to show that there are no dangers connected with company control which cannot be removed or restricted. To place undertakings entirely and constantly in the hands of municipal officers, leaves unlimited possibilities for corruption; but the dealings with companies can be made of a periodic nature which must attract public attention, and offer little or no opportunity for such corruption. The making of burdensome provisions for the control of public undertakings is what forces many owners of them into politics. Further, the advocates of municipal ownership hold that the municipal government has a right to condemn and purchase any public utility concern on the basis of the appraised valuation of the present worth of its property. This would often mean purchase at a price much less than its cost to the present owners or original builders, and would always mean the direct confiscation of any value in excess of the original cost of the plant or its present valuation. The author gave some striking examples of this, and remarked that municipal ownership of the properties concerned could not be effected on the plans of the advocates without doing grave injustice to the present owners.

In bringing his long and interesting paper to a close, Mr. Doherty expressed the opinion that if ever municipal ownership should become at all general, it would, owing to lack of personal interest, legal restrictions of management, and unwarranted criticisms of managing officers, cast a blight on the progress of the lighting business; and instead of leading the world in this art, America would lose supremacy. The methods which had made America rich and powerful were, he said, good enough for him. Those who wished might take their example from the nations which were travelling towards the dark. America was already in the lead, and was still climbing; and should it ever start downward, he was thankful he would not be alive to see it.

Incandescent Gas for Lighthouses.—For about a month the illumination of the Eddystone Lighthouse has been engaging the attention of mechanics from the Trinity House. These experts have installed a powerful duplicated incandescent system of gas lighting; so that if a set of lights at any time fail, there will be one to rely upon. The old oil-lamps have been superseded; and the new light sheds far longer and more penetrating rays than were possible by the use of oil.

Verification of Standards.—According to the report of the Board of Trade of their proceedings under the Weights and Measures Acts in the period from Aug. 1, 1902, to the 11th of August last, gas-measuring standards were verified for the Aldershot, Shepton Mallet, Wellington (N.Z.), and York Gas Companies; for the Bradford, Doncaster, Dublin, Faversham, Glasgow, Helensburgh, Manchester, and Middlesbrough Corporations; for the City of Perth; and for the Melbourne Gas-Testing Authorities. Standard sizes of gas-meter connections (unions, &c.) were also tested.

The Late Mr. Fletcher.—Probate of the will of the late Mr. T. Fletcher, the amount of whose estate was mentioned in the "JOURNAL" for Nov. 17, has been granted to his nephew, Mr. Charles Clare, of No. 134, Queen Victoria Street, and to Mr. W. J. Forshaw, of No. 42, Sankey Street, Warrington. The testator bequeathed his scientific and technical books having his name plate therein, and his personal belongings marked with his name or monogram, to his son Thomas William, and his household effects to his daughter Mary; and he left his residuary estate in trust to pay the income of £11,000 to his son Ernest Lyon during his life. Subject to his life interest in this sum, the residuary estate is to be held in trust for the testator's daughters, Mary Fletcher and Alice Healey, and his son Thomas William. It may be remembered that two years ago the late Mr. Fletcher gave a sum of £1000 for distribution among his workpeople.

GAS-ENGINES AND THEIR FUELS.

At the recent Annual Meeting of the American Gaslight Association, Professor ALFRED H. WHITE, of the University of Michigan, delivered a lecture on the above subject. The text is given in the number of the "American Gaslight Journal" for the 16th ult., from which we make the following extracts.

The art of constructing large gas-engines has made enormous strides in the last few years. Engines of 500-horse power are no longer considered large, and those of 1500-horse power are being built; but we hear very little of large gas-engines for illuminating gas. Almost all of them are built for fuel gas and many for blast-furnace gas. The discovery that this gas could be profitably used in gas-engines has raised quite a *furore* in the Engineering Press, because of the vast possibilities of waste power that may thus be made useful. If all the blast-furnaces of the United States were equipped with gas-engine plants, there would be 1½ million horse power generated over and above the needs of the furnaces for all purposes. Blast-furnace gas is so poor that it will scarcely burn in the open air; and ten years ago the proposal to use it in gas-engines was received with scorn. But to-day we find that, out of 100 heat units supplied to the engine, there are transformed into useful work in the case of engines fed with blast-furnace gas as many as, and often more than, with engines using lighting gas; and one of the builders of large gas-engines has stated as his ideal gas for them one which is, to all intents and purposes, the once despised blast-furnace gas.

The earlier gas-engines were all built for illuminating gas; and the adoption of the lower-grade power gases has been a growth of recent years. What is it that has caused such a change of sentiment among some at least of the gas-engine builders? It is to this phase of the subject—the influence of the kind of gas used—that I propose to devote the time allotted to me. Its consideration involves some study of the phenomena which take place in the engine cylinder.

The cylinder is the most important part of the engine, because there the power is developed, and there the most serious sources of loss reside. The operation is apparently simple. A combustible gas is mixed with air in proper proportion, and ignited. The gas rapidly burns (explodes) to carbon dioxide and water; and the heat set free expands the gases, which do work on the piston. But the first step in remedying a fault is to find out where and exactly how great it is; and when we try to analyze the various sources of gain or loss in the cylinder, we find ourselves possessed of very little certain information as to what goes on there beyond the fact that a mixture of gas and air is drawn in, that combustion takes place, and that later the products are ejected after doing a certain amount of work.

It was the advent of the Otto engine in 1876 which brought the gas-engine into the realm of commercial practicability; the feature of value being the compression of the air and gas charge previous to its explosion. To effect this, Otto boldly cut loose from all traditions, which were to give the piston an impulse every time it went forward, and gave the piston an impulse only on every alternate forward stroke, or one impulse for every four strokes. [The lecturer explained the action of the piston by means of an indicator card.] The efficiency in an engine of this type, as deduced theoretically, may be shown to depend almost entirely upon the amount of compression to which the gases are subjected before explosion. The higher the compression temperature, the more efficient the engine. Practice has shown results according fairly well with theory in this respect, and the natural result has been that manufacturers have kept increasing the compression temperatures until they have been forced to call a halt because of limitations set upon them by the nature of the gas used.

When a gas is compressed to (say) one-fifth of its volume in as small a fraction of a second, the energy required to effect its compression is almost entirely converted into heat, which raises the temperature of the gas. The greater and more rapid the compression, the hotter does the gas become, and it is easy in practice to heat a charge of gas and air so much that it will prematurely explode in the cylinder. The danger of this is greater in large engines than in small, because of the relatively smaller cooling effect of the walls in a large engine. The strains due to premature explosion are also more serious in a large engine. Of all the gases, hydrogen is the one which most easily explodes under these conditions, and hydrogen is an important constituent of most of our commercial gases.

This danger of premature explosion puts an effective bar on too great increase of compression before explosion. It is because of the possibility of safely compressing blast-furnace gas more than other gases that this gas has become such a favourite with some engineers. Blast-furnace gas will carry about 30 per cent. of carbon monoxide, 3 per cent. of hydrogen, and the remainder will be carbon dioxide and nitrogen. This gas mixed with a favourable proportion of air will hardly burn, much less explode, with the promptness and certainty requisite in a high-speed gas-engine. It is necessary to heat it by compression to make it explode; and compression may be safely carried much farther with it than with the gas containing much hydrogen. For equal amounts of compression, blast-furnace gas shows a much lower efficiency than a rich gas; but with a greater compression, an efficiency almost equal to, and sometimes better than, its old-time superior. Let us see if we can find any explanation for this.

It will be of interest to compare the theoretical flame temperatures and the volumes of the products of combustion at the elevated temperatures.* Let us take for comparison carburetted water gas, blue water gas, and blast-furnace gas, and determine what pressures would be exerted by the explosion of each with the theoretical amount of air. It will be convenient to assume an engine with a cylinder containing a charge of 1 cubic foot. The piston is not supposed to move during explosion, which takes place at constant volume. We may calculate the theoretical temperature of combustion, and from it the theoretical pressure that would be produced.

The theoretical temperatures may readily be calculated if we know the composition of the fuel, the quantity of air used, and the specific heats of the products of combustion. It is in connection with these specific heats, that the greatest uncertainty arises. The specific heats of the products of combustion, as obtained by Regnault from his experiments at ordinary temperatures, gave preposterously high temperatures as theoretically possible. In 1883, Mallard and Le Chatelier, by their classic researches on the explosion of gases in closed vessels, obtained experimental data on the specific heats of these combustion gases at higher temperatures, and showed conclusively that the heats rise rapidly with increase in temperature. The principle of this work has been confirmed by others, although there is considerable divergence in the numerical results obtained by different experimenters. In the absence of any authoritative revision of their work, however, the Le Chatelier specific heats are probably those most frequently used by engineers.

In the calculation of theoretical specific heats, we assume that combustion is complete and instantaneous, that there is no dissociation of the products of combustion, and that all the heat produced is used in raising the temperature of the gases remaining after combustion. For this calculation, we must know the amount of heat developed by the combustion of a given quantity of gas, and the amount as well as the specific heat of each constituent in the products of combustion. From the temperatures thus obtained, and a knowledge of the amount of air required for complete combustion, it is possible to calculate the pressures that would be developed by the three gases under like conditions.

When combustion of these gases takes place, there is always a diminution in volume due to chemical combination. This may most conveniently be allowed for by assuming that the heat acts upon the gases of combustion at the volume which they would have when cooled. As this volume is less than 1 cubic foot, and the gases still fill the 1 cubic foot cylinder, it follows that they are under reduced pressure. What this is may be calculated from the ratio of the volumes under constant pressures of the gases before and after explosion. In carburetted water gas, for example, the relative volumes are 6·90 before, and 6·68 after, explosion. From this it follows that the combustion gases in the cubic foot cylinder are under a pressure of $\frac{6{\cdot}68}{6{\cdot}90} = 0{\cdot}967$ atmosphere. The formula for explosion pressure is $\frac{p}{1} = \frac{t}{1}$, where p is the initial pressure, $p\,1$ the explosion pressure, t the initial temperature absolute, and $t\,1$ the explosion temperature absolute. In the case of the carburetted water gas previously referred to, $\frac{0{\cdot}967}{p\,1} = \frac{290}{2463}$. The explosion pressure $p\,1$ is then 8·02 atmospheres. We may now tabulate the data for the three gases as follows:—

	Carburetted Water Gas.	Blue Water Gas.	Blast-Furnace Gas.
Net heating value, B.T.U. per cubic foot	673·000	278·000	111·000
Volume of air required for 1 cubic foot of gas	5·900	2·210	0·792
Volume of products of combustion from 1 cubic foot of gas	6·680	2·750	1·627
Volume of charge in a cubic foot—			
Gas	0·145	0·311	0·558
Air	0·855	0 689	0·442
Temperature of explosion at constant pressure, degrees C.	2190·000	2145·000	1690·000
Absolute temperature	2460·000	2418·000	1963·000
Initial pressure of products of combustion, in atmospheres	0·965	0·855	0·908
Pressure of explosion, in atmospheres	8·020	7·130	6·150
Relative volume of gas in charge, carburetted water gas being 1.	1·000	2·010	3·850

The pressure generated by the blast-furnace gas is considerably the lowest. But remembering the advantages to be gained by compression, it will be worth while to consider the results given by this gas if the charge is compressed before explosion to, for example, 10 atmospheres. Using the formula for the temperature of adiabatic compression, the temperature of explosion will be raised to practically 290° C., or from 1963° to 2255° absolute. Using the same formula as before for the calculation of the pressure caused by this rise in temperature, we find $\frac{0{\cdot}908}{p\,1} = \frac{290}{2255°}$. From this, $p\,1 = 7{\cdot}06$ atmospheres, as the increase of pressure caused by the explosion.

* In connection with his lecture, Professor White prepared a number of calculations for inclusion in the "Transactions" of the Association.

We may now summarize the results of these comparisons as follows:—

	B.T.U. per Cub. Ft. Gas.	Relative B.T.U. per Cub. Ft. Charge.	Explosion Pressure. Atmos.
1 volume of carburetted water gas without compression	673 ..	673 ..	8·02
2 volumes of blue water gas without compression	278 ..	556 ..	7·13
3·85 volumes of blast-furnace gas without compression	111 ..	429 ..	6·15
3·85 volumes of blast-furnace gas with compression to 10 atmospheres .	111 ..	429 ..	7·06

These figures indicate that when the charge is previously compressed to 10 atmospheres, 4 volumes of blast-furnace gas are practically equal to 2 volumes of blue water gas without compression; and that, under like conditions, 2 volumes of the latter gas are almost as good as 1 volume of rich carburetted gas. This gives some explanation of the rapid development of the blast-furnace gas-engine, which can work with higher compressions than engines burning hydrocarbon fuel. Does it also mean that the richer gases must always be at a disadvantage in this regard? Not necessarily.

Attention has of recent years been drawn again to a type of engine well known, but never successfully introduced into practice. Interest in this type has been aroused by the success of the Diesel petroleum motor. In this engine, the piston on its return stroke compresses air only to a high pressure and a temperature hot enough to ignite any combustible. Just as the piston is at the dead-point, petroleum is injected into the cylinder, and ignited instantly on coming in contact with the hot air. Although this has been worked out on the large scale only for a petroleum motor, there seems no reason why the principle should not be successfully applied to gas. The gas may be compressed by a separate pump to a pressure sufficient to enable it to be forced rapidly into the cylinder at the proper moment. There can be no question here of premature explosion; and the only limiting condition would seem to be the mechanical one of making an engine to stand the strain.

The formula for calculating the theoretical efficiency of an engine of this type is not so simple as with the Otto engine. Efficiency will increase with the compression; but there will be involved the temperatures of compression, combustion, and exhaust. It is almost useless to try to calculate the behaviour of the engine if we also have to derive from rather uncertain theoretical data all three of these necessary temperatures. They are factors which it is extremely difficult to measure. The charge is compressed, exploded, and exhausted in a fraction of a second, and it is almost impossible to obtain measuring instruments to register such rapid changes.

Whenever we try to forecast the results of changes in a gas-engine, or even to interpret the results of experiments on our present engines, we are brought face to face with the painful inadequacy of our information on the subject of combustion in general and the operations in the gas-engine cylinder in particular. The first step towards improvement is the determination and location of the present sources of loss. We can determine the loss of heat to the jacket water, apparently inevitable and relatively constant. We can determine the loss due to the high temperature of the exhaust gases and to imperfect combustion; the latter, as Professor Mayer's researches have shown, being small with engines at full load running on lighting gas, considerably larger at half-load, and rising to important proportions in engines using low-grade gas. But we can only explain fully the the results obtained when we are enabled to follow accurately every step of the process of conversion of chemical energy into power. The cylinder of the gas-engine is still largely a sealed book. We do not know how rapidly explosion takes place, nor how high temperatures are obtained. The very data on which the calculations just presented have been based are somewhat uncertain.

The design of a gas-engine is almost entirely a matter of practical experience. Like its governing, it is of the "hit-or-miss" order. Progress has been made, in spite of drawbacks; but nothing like the advance which would follow a scientific knowledge of the underlying phenomena. The Institution of Mechanical Engineers deserve great credit for their support of research work on this subject for the past five years. Valuable results have been obtained; but the subject is too large and complex to be solved by any one set of investigators. It must be worked out bit by bit by many workers, with the expenditure of much time and money; but the results will be well worth the effort, and will redound to the honour of all who have furthered the work.

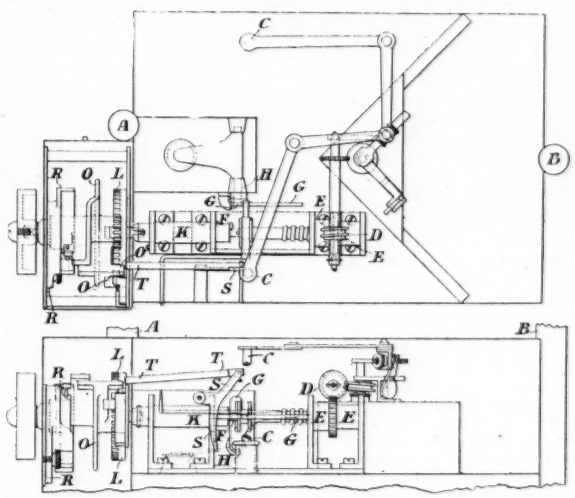
North British Association of Gas Managers.—The report of the proceedings at the 42nd annual meeting of the Association, held in Ayr on the 30th and 31st of July, under the presidency of Mr. T. Lighbody, of Renfrew, has been issued in pamphlet form. It is, as usual, accompanied by the rules and regulations, a list of members, and the accounts; and appended to these is the Statistical Report of the Gas Supply of Scotland, from July 31, 1902, to Aug. 1, 1903, prepared by the Committee. The pamphlet has been produced under the supervision of Mr. R. S. Carlow, the Secretary of the Association.

REGISTER OF PATENTS.

Prepayment Gas-Meters.—Pinchbeck, J., of Clerkenwell, E.C. No. 28,911; Dec. 31, 1902.

This invention relates to improvements in the meter described in patent No. 5656 of 1899—as shown in the plan (with the case removed) of an ordinary gas-meter to which apparatus has been added to make it a prepaid meter, and a side elevation.

A is the inlet-pipe and B the outlet. C are spindles caused to oscillate by the passage of the gas, and which, by means of links, rotate a spindle which has fixed to it a worm gearing with a worm-wheel fixed



to a shaft, by which the counting and recording mechanism is actuated. These parts all belong to ordinary gas-meters, and require no further description.

D is a worm fixed on a shaft, and gearing with a worm-wheel forming part of a sleeve E. The sleeve has an internal screw-thread, and contains a screw plug fixed to a square rod F. The end of the rod has fixed to it flanges embracing a sleeve, to one side of which is fixed an arm. The other side of the sleeve is forked, and embraces a horizontal guide. The arm works along the lever G fixed to the spindle H of the valve on the gas-pipe A. As gas is consumed, the shaft is rotated, and the rod F is moved from right to left; and when the screw comes to the end of the sleeve E, the arm drops into a notch in the lever G, allowing the lever to rise and close the valve, and cut the gas off. There is a stop against which the lever J comes. K is a sleeve through which the rod F passes, but which is prevented from moving longitudinally by the framing. The end of the sleeve is connected to a crown-wheel L, which is prevented from being turned in one direction by a pawl. This wheel is turned on the introduction of a coin or coins thereby rotating the rod F and screw—screwing the latter into the sleeve E, and thus moving them from left to right. O is a disc fixed on a shaft O^2 worked by the handle shown, and with projections or jaws on the sides of it.

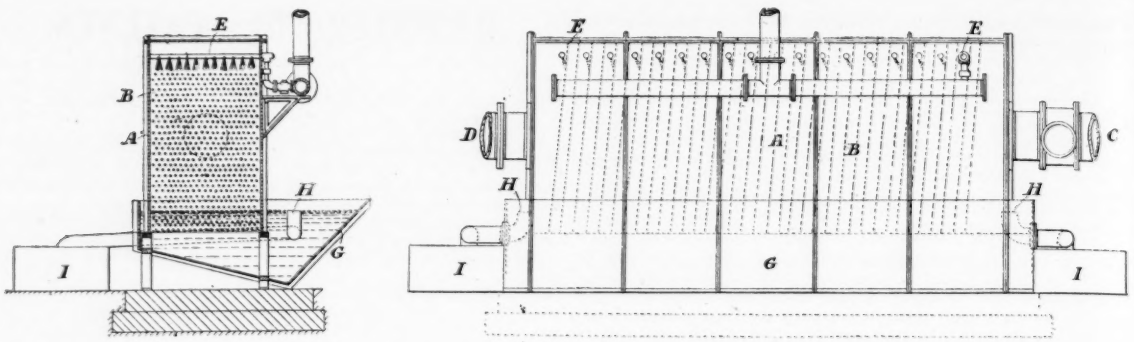
On a coin being introduced (the parts being in the position shown), it falls into the slot between the jaws on the disc O, and also engages with the teeth of the crown-wheel L, and is supported by the flange of the plate R. On the handle being turned, the disc and crown-wheel all rotate together—being connected by the coin; and the rod F is therefore rotated, moving the screw as described. So long as the coin remains in place, the handle cannot be turned back again—being prevented by a pawl which engages with the crown-wheel L; but when the coin comes to the end of the flange and drops out, the handle is disconnected from the crown-wheel, and can be turned back freely, carrying with it the disc O. The angle through which the handle and other parts can be rotated for each coin is limited and regulated by the stop carried by the plate R, which is secured in any desired position by a screw which engages with one or other of the holes.

When the last of the proper maximum number of coins is being introduced, and the rod F and nut are therefore approaching the end of their travel to the right, the hook fixed to the rod F engages with the lever S, and thus causes the pin T to protrude into the path of a lug fixed to the disc O, so that the handle cannot be fully turned back and another coin introduced until enough gas has been consumed to move the hook out of engagement with the lever S, which then falls by its own weight and withdraws the pin T. The end of the hook works in a slot in the case, and indicates on a scale the number of unexpended coins.

Removing Tar and Solid Particles from Gases.—Beilby, G. T., and Christison, G., of Glasgow. No. 28,614; Dec. 27, 1902.

This invention more particularly relates to the removal of tar and solid particles from fuel gas by subjecting it to a washing or scrubbing process.

Gas is led through the chamber A (p. 622), containing a series of perforated plates B, through which perforations the gas passes on its way from an inlet C to an outlet D. The plates are spaced at convenient distances from each other, and are set at an inclination. Along the upper edges of the plates, pipes E are led for the supply of washing liquid, intermittently or continuously discharged through jet orifices at E over the whole upper surface of each plate. As this is the surface



of the plate against which the current of gas impinges, the tar particles are arrested and swept down by the sheet of liquid.

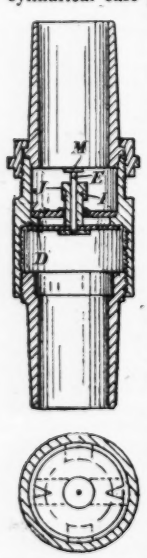
The chamber in which the plates are set is closed on the sides and top, but the bottom is open and dips under the surface of the water contained in a trough G, which effectually lutes the chamber; while as the plates reach to the bottom of the chamber, they also dip into the liquid and are luted. The luting trough G has one or more of its sides sloped to facilitate the removal of the tar washed out of the gas; and overflows H are provided so that a constant level may be maintained in the trough. The overflow is led into and through separators I for the further clearing of the liquid before it is discharged into drains or returned into the washer.

The washing liquid is preferably supplied to the plates from automatic flushing cisterns placed overhead, and into which the liquid may be raised from the separators by pumps. For the removal of tarry impurities, oil is used as the washing liquid.

Concluding their specification, the patentees say: We are aware that washers are in use in which the wetted surface of blades or plates is used to arrest the solid or liquid particles suspended in crude gases, and that various means have been employed for distributing the gas and for maintaining the wetted surfaces in a suitable condition. But the more efficient of these washers require to be provided with mechanically moving internal parts in addition to arrangements for the moving of the washing liquid through the apparatus. According to our invention, the distribution of the gas as well as the efficiency of the wetted surfaces is ensured, without mechanical movement of the internal parts, by so arranging the wetted surfaces that the washing liquid alone is able to sweep and renew them; the impurities being washed down into the lower part of the apparatus, from which they can be removed without interrupting the regular working. This is accomplished by disposing the wetted surfaces in the form of plates set at such an angle that a stream of liquid discharged along the top can sweep the plate from top to bottom, leaving the surface clean and wet. The plates are perforated for the passage of the gas, which is thereby broken up into streams of suitable fineness—the streams from one plate striking upon an unperforated part of the succeeding plate.

Regulating the Pressure of Gas.—Withington, W. H., of Buxton. No. 298; Jan. 6, 1903.

For the purpose in view, the patentee proposes the combination of a cylindrical case provided internally with a bridge-piece and valve-seating in which indents are cut, with a valve also provided with indents, and a weight placed upon the spindle of the valve, the flange of the weight resting on the bridge—all arranged as shown.



The cylindrical case is provided internally with a bridge, below which a seating is formed on which the valve D can bed. The valve is preferably of the mushroom type, and is fixed on a spindle E, which passes through a hole in the centre of the bridge. It is made of such a size that it will move easily within the case and admit of a free flow of gas around it. In the valve are cut two indents, and also in the seating are two other indents, the use of which will be explained later. Fitting loosely on the spindle is a small weight I (through which the spindle can move), formed, as shown, of a smaller diameter at the lower than at the upper end. The lower end fits loosely in the hole of the bridge, the flange J resting on the bridge and supporting the weight. The upper end of the spindle is provided with a small flange, preferably soldered to the top of the spindle.

The action of the device is as follows: At the normal pressure, the valve D is at its lowest point, with the flange M resting on the upper face of the weight I, the flange J of which is resting on the bridge. On any increase of pressure, the valve is lifted and comes in contact with the weight, which (if the pressure continues to increase) is raised until the valve beds on to its seat. In order that the supply of gas shall not be entirely cut off, the indents before mentioned allow a sufficient quantity to flow through for the maintenance of the light from (say) five burners.

Generating Water Gas.—Clauss, F., of Meerane, Saxony. No. 1090; Jan. 15, 1903.

In an earlier patent (No. 8239 of 1899), the inventor described a process for the continuous generation of water gas, wherein a mixture of steam and carbonaceous material was to impinge, in a closed decomposing chamber, against a surface maintained at a glowing heat by external means, with the result that the steam was decomposed by the carbon, and water gas was formed. According to the present invention (especially advantageous, it is said, in the case of small apparatus), the mixture of steam and carbon is not produced by the action of a jet of steam upon the carbonaceous material, but both water and carbonaceous material are introduced directly into the decomposing chamber, and the water is allowed to evaporate therein, so that only just the quantity of water is converted into steam which is required at the time for the purpose of generating the gas. The water is preferably introduced into the decomposing chamber in a condition of the finest possible subdivision—that is to say, in the state of fine spray. (See patent No. 1091 *post*.)

Generating Water Gas.—Clauss, F., of Meerane, Saxony. No 1091; Jan. 15, 1903.

In a previous patent (No. 8239 of 1899), the inventor, as mentioned above, described a process for the continuous generation of water gas, wherein a mixture of steam and carbonaceous material is caused to impinge, in a closed decomposing chamber, against a surface maintained at a glowing heat by external means, with the result that the steam is decomposed by the carbon, and water gas is formed; while, if desired, oxygen in any suitable form may be admitted into the decomposing chamber, either together with the mixture or separately therefrom. In his patent No. 1090 of 1903, he specified that, instead of steam, water—which may be in a condition of fine subdivision or spray—may be employed. The mixture of the steam with carbonaceous material requisite for the generation of water gas, according to this patent of even date, is effected while the carbonaceous material is injected by means of a steam jet; and it is specified that a mixture of steam and carbonaceous material is, by the action of a steam-jet upon carbonaceous dust, conveyed into the closed decomposing chamber.

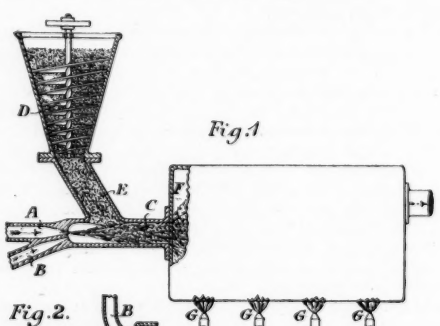


Fig. 1

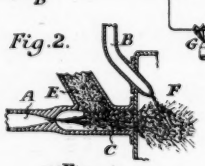


Fig. 2.

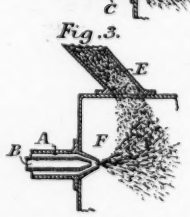


Fig. 3.

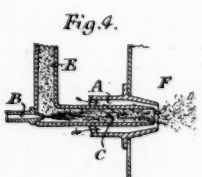


Fig. 4.

The present invention has reference to improvements in this process; and according to it, under certain circumstances—as, for example, when the pressure of the steam is not sufficient to inject the carbonaceous material, the mixture of steam and carbonaceous material is produced (1) either before it is introduced into the decomposing chamber, such introduction being effected by means other than the injector action of a steam-jet, as, for instance, by compression; or (2) the mixture of steam and carbonaceous material is produced, not before but after its introduction into the decomposing chamber—the two materials being separately introduced into the decomposing chamber by any suitable means. In the second of the alternatives mentioned, it is obviously possible to introduce the two materials into the decomposing chamber either through the same aperture or separately. It is also obvious that in both cases, not only carbonaceous dust, as described in the prior specifications, but also liquid hydrocarbons, or liquids containing these substances, may be employed; and again in both cases, if necessary,

with the simultaneous employment of oxygen in any suitable form, as also described. Finally, it will also be understood that in all the foregoing cases, in place of steam, water in a state of fine subdivision or as spray, as provided in patent No. 1090 of 1903, may be used.

Fig. 1 represents in side elevation, partly in section, a construction of apparatus in which the carbon-dust is mixed with steam or finely pulverized water and, if necessary, also with oxygen before its admission to the decomposing chamber. This admission takes place by pressure instead of by suction, inasmuch as high-pressure steam or compressed air or water under pressure, or two such mediums or substances, act simultaneously from the nozzle-pipes A and B upon the carbon-dust fed into the mixing-tube C through the feeding-tube E, by means of a feeding-screw D, to force the carbon-dust gradually into the mixing-chamber F, which is heated externally by means of sources of heat G.

Fig. 2 shows a modification in which the carbon dust and water are mixed together before their admission to the decomposing chamber F. In this case, the steam or water under pressure forces the carbon dust into the decomposing chamber, while oxygen, in the form of a jet of compressed air, is introduced immediately into the chamber. The position of the mouths of the tubes within the decomposing chamber is preferably such as to cause the air-jet to meet the mixture of carbon-dust and water, and to force the mixture against the heated wall of the chamber.

Fig. 3 shows another modification, in which the carbon dust is introduced directly into the decomposing chamber F, and steam or water alone or in combination with air are injected in a state of fine subdivision. In this case, the mixing with the coal dust takes place in the decomposing chamber only.

The same process takes place in a further modification shown in fig. 4, in which the three tube-nozzles A, B, C are arranged concentrically one within the other, and the carbon dust is forced into the decomposing chamber F by the pressure of a jet of compressed air.

Purifying and Cooling Gas-Producer Gases.—Boyd, H., of Thornton, Lancs. No. 1182; Jan. 17, 1903.

This invention, relating to apparatus for purifying and cooling gas-producer gases, is specially intended to be used for the treatment of gas made from bituminous coal or lignites, but may also be employed for the treatment of gas produced from anthracite or coke fuel. The sensible heat of the gas issuing from the producer (which may be of any suitable form) is utilized for the production of steam under pressure sufficient not only to supply the air for combustion to the producer—either by means of a driven fan or by a steam-jet blower direct—but also to drive an engine which works a fan and pumps used in connection with improved apparatus in which the gas is first purified, so as to separate the tar and dust from it and afterwards cooled down; the resultant gas being suitable for use in gas-engines and for other purposes.

Photometrical Apparatus (The "Flicker" Photometer*).—Simmance, J. F., and Abady, J., of Page Street, Westminster. No. 4693; Feb. 28, 1903.

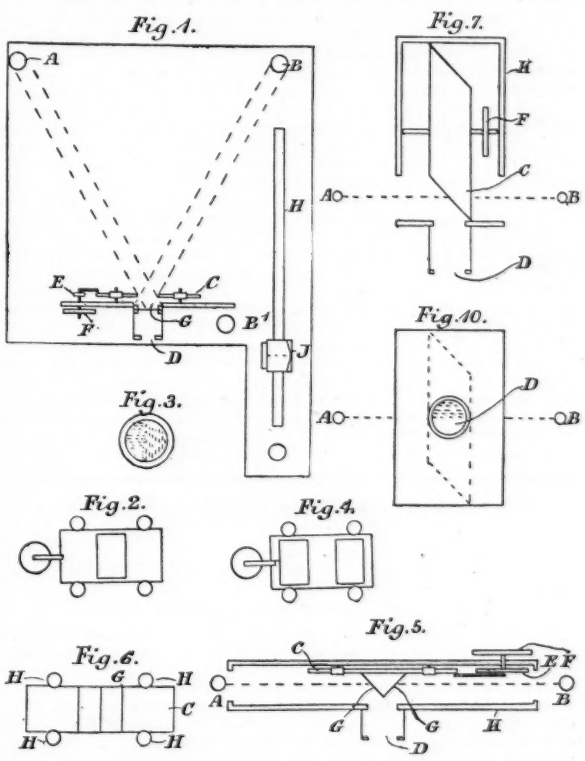
In their specification, the patentees remark: Careful investigation and experiment have proved that the physiological causes of the little-known optical phenomena described herein have been hitherto misunderstood, and attempts to utilize them in photometry have in consequence been abortive. The blurring, flickering, or throbbing effect produced upon the eye by the rapid alternation of rays from the light under test and a comparison light (each of a distinct tint and intensity) is caused by the anxiety of the nerves controlling the dilation and contraction of the pupil to fulfil their office; while the effort to do so is frustrated by the rapid changing. The relief afforded by the arrival at equal intensities of the two lights signals unmistakably the point when such quality has been reached.

The arrival at a true explanation of the phenomenon has enabled the patentees to delineate distinctly the rules and considerations which must be adhered to to produce the effect in a useful manner. The points which must go to the successful making up of a photometer on the principle to be described for the measurement of lights of different tints may be detailed thus: The light effects must be in juxtaposition, without any apparent division line; and they must move, oscillate, or rotate so that the point of juncture of the rays of the two lights passes and returns entirely across the vision-field. Any hiatus, or longer exhibition of one light than the other, biases the result. The observation surfaces (or surface) upon which the light rays fall must be at exactly the same distance from the eye, at exactly the same angle in relation to the line of sight, and must be of a pure white—such as is afforded, for example, by a clean chalk, gypsum, or plaster of Paris. Any tint affects the accuracy of the result. The observation surfaces must also themselves in turn occupy the field of vision. An apparent movement or optical illusion does not afford accurate results on account of not enabling the photometrical law of inverse squares to hold good.

The application and result of the whole may be summed up as follows: To arrive at the comparative intensities of lights, it is usual to allow rays from one of unknown power and also one of known power to fall upon a prepared surface, and there to compare the illuminating effect, which, however, presents difficulties when the lights are of differing tints. The proposal, therefore, is to interpose between the lights and the illuminated surface an arrangement which will, at will, cut off the rays of either light, but not both entirely; or else portions of each light can be obscured, leaving only visible on the illuminated service the part where the two rays come in contact. Thus a suitably slotted plate will allow both beams to fall side by side if the receiving surface is at the proper distance from the slot; while by moving the slotted plate, either light can be shut off and the receiving surface only receives the ray from the other. Thus with two lights, one red and one blue, the slotted plate placed at one extremity of its slide will let fall upon the receiving surface a beam of (say) red. Moving the plate slowly across the field, the blue ray enters, and the two colours are side by side. A further movement in the same direction, and the field is entirely blue. It is found that the eye is only sensitive to these changes of colour when the plate is moved comparatively slowly; when moved rapidly to and fro, only a blurred image with a throbbing effect is exhibited. This only results when the lights are of unequal intensity; when equally intense, the two colours blend into a homogeneous tint, and no throbbing is shown. Thus relative intensities of compared lights can be estimated, either by simply comparing the two lights side by side on a receiving surface—and this only yields accurate results when the lights are nearly or of the same colour, and does not in any case eliminate the "personal" error—or by causing the cutting-off plate to oscillate at a suitable speed, which enables the relative intensities of lights of widely differing colours to be estimated with certainty. A finger of wood or metal (moved in front of the receiving screen, so as to cut off each light alternately) acts in the same way as the slotted plate, or a wheel with suitable vanes revolved has the same effect. In these instances, the rays of light pass direct from their source to the eye, or rather to the intervening translucent screen or receiving surface.

This description applies, in principle, says the patentees, to all the forms which constitute perfect colour-photometers; and the effect to the eye is the same in every one of the forms described in this specification. It is stated, however, that the flicker effect brought into play is totally different from that of rotating sectors used practically for the reblending of spectral colours. In that case, persistency of vision is relied upon.

The inventors proceed to describe generally some of the forms of



photometers, all complying with the principles formulated as being essential to the proper embodiment of their invention, and subsequently they describe, particularly, the various forms. They here mention that there are many other obvious ways of carrying out the invention; and it is for this reason that they have carefully detailed the precise rules by which they conceive that the invention must be guided in order to obtain efficiency. They, therefore, do not limit the invention to the new forms shown; but these sufficiently show the principles involved, and which are declared to be novel.

In fig. 1 (plan) A and B are the lights, one of which is to be tested and the other to be a variable light of which the power is known or may be ascertained. C is a plate or shutter with a rectangular aperture through which rays from A and B pass. G is a translucent screen or disc, and D is a sighting tube. E is a crank, causing the oscillation of C, which is turned by a belt from a suitable motor passing round F. The rays from A and B form two rectangular images side by side on G, and are viewed through D, which tube has a hole which causes the screen or disc G, when the motor is at rest, to have the appearance shown in fig. 3. This appearance is only apparent when the slide C is at half-slide. When it completes its stroke, the appearance through D is of a clear spot of either one colour or the other. When the motor is running and the screen vibrating, these appearances, however, cannot be perceived at all. When the lights are unequal, the disc shows a rapid throbbing; but when the intensities are equalized, the disc becomes a clear, steady blend of the two colours. Therefore, the appearance shown in fig. 3 (never seen when the slide is oscillating) can be produced by turning the wheel F slowly by hand when the motive power is at rest.

H is a graduated bar, J any convenient form of disc box, and K a standard of light—such as a Simmance 1-candle pentane standard

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* Several references to this apparatus have already appeared in the "JOURNAL." See Vol. LXXXII., pp. 138, 664; and Vol. LXXXIV., p. 22.

flame. In use, A is a coloured light, B an argand gas-burner, with cock shown B^1. By turning the cock until the throbbing effect on the disc or screen ceases (indicating equality of intensity), the point is arrived at when A and B are of the same power. B, being of the same colour as the standard light K, can now be measured by means of the disc box J, and the indications read on the bar H.

Fig. 2 is the plate C, showing the form of slot; while fig. 4 is a similar plate, differently slotted. The "finger" formed by the centre bar shuts off each light in turn—thus alternating the rays on the screen G (fig. 1) in exactly the same manner as was described in figs. 1 and 3.

Fig. 5 shows the lights A and B moved to right angles with the line of sight. C is the oscillating slide running in guide wheels, and G is the surface receiving the light rays and reflecting them up the sight tube. E F are as described in fig. 1. K is a box enclosing the oscillating screen. The rays from A and B fall upon the pure white surface G, and, viewed through D, form a continuous field; the apex of the prism being undistinguishable. When the slide C is at each end of its stroke, the reflected rays from each light are seen alternately, and the effect and the appearance through D is exactly the same as in the previously described forms. The slide C and the prism G are shown in elevation in fig. 6; the guide wheels being lettered H. This form is conveniently used by being mounted in a suitable box (K in fig. 5) on rollers; apertures being provided for the entry and exit of the light rays. Thus, after starting the motor, the box may be moved by hand between the lights A and B until equality is observed. B may be in this case an actual standard of light—such as a pentane lamp; and the relative distances being measured, the power of A can be calculated in terms of B. A graduated scale between A and B is most convenient.

Figs. 7 and 8 are a plan and elevation of a rotating reflecting surface instead of an oscillating one. The wheel C has its periphery cut in such a way that it presents alternately an oblique face to the lights A and B; and in its rotation it exhibits these faces illuminated by the different lights to the sighting tube D. The advantage of this form is its slower movement, as it is obvious that if it is made in six divisions (bevelled each way) it alternates the surfaces to the vision three times in each revolution, and thus can be driven at a third of the speed of the forms shown in figs. 1, 4, and 5. Apart from this, the effect is identical, with the slight exception that, when at rest and rotated by hand slowly, the two coloured halves of the disc apparent through D are one above the other, as shown in the front elevation, fig. 8.

Concluding this lengthy specification, the patentees remark: We recognize the fact that the speed at which the oscillations or rotations of the slides or wheels takes place is important, as with lights of low power greater sensitiveness is obtained by slower revolutions; while with high intensity lights, a greater speed is desirable. But the range of each speed is great, and the forms of motive power familiar to scientists afford means of easy adjustment. We ourselves have used electric and water power, hot-air engines, compressed air engines, clockwork, and hand power with success. Another point which must be carefully seen to in using our invention is the accurate alignment of the lights. It should be pointed out that the contrivances herein described are by no means only suitable for use with lights of different tints. We have found that with lights of the same colour the arrangements described afford means for very delicate tests, as, until the two lights are equal in intensity, the throbbing or flicker effect is marked.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Use of Flueless Gas Warming Stoves.

SIR,—Having seen the remarks made by you, with regard to the above, in your issue of the 24th ult., and having had much experience in the manufacture of this kind of apparatus, I write to say it is with some considerable surprise that I see offered for sale by some gas companies, stoves of this description in which there are faults of construction, and cheap foreign-made fittings, which no doubt have been offered to them as new and improved methods, but which were discarded by me many years previously, as having all the elements of deadly danger.

As one instance, I may mention that a condensing gas-stove made with copper or brass tubes is, in itself, a complete apparatus for the manufacture of sulphate of copper; and in old stoves of this kind I have found large lumps, which have been formed. For this reason, I ceased to make stoves of this description with copper tubes. Since then the new Factory Act has come into operation, and employers of labour, for their own interests, should not be offered stoves of this kind made in a manner which may cause injury to those they employ, but which they take on the recommendation of the officials of gas companies, who are supposed to have a thorough knowledge of what they have in their show-rooms.

The Carron induction stove which you described in the "JOURNAL" last year, was designed by me to overcome all previous defects in this kind of apparatus. The novelty of the system has been acknowledged in the United States, where a patent has been granted for it. As our Government Factory Inspectors have taken the matter up, they will no doubt follow it out step by step, and find (what was clearly evident to me some years back) that all the old systems of heating with condensing gas-stoves were more or less defective, and that it was necessary to look for some other method of producing the action than that of merely causing the hot products to pass over metal surfaces cooled by the air passing through a system of tubes in the apparatus.

F. R. E. BRANSTON.

Victoria Street, S.W., Dec. 4, 1903.

Oxygen in Purification.

SIR,—With reference to my remarks upon the above subject at the recent meeting of the Southern Association, I now wish to add to them the name of my authority for the statement that at temperatures sometimes obtaining during purification, sulphurous acid is producible; oxygen and moisture being present. Having previously obtained permission to give the name if occasion arose, I might have done so then and there. But I had not anticipated the discussion; and knowing how easy it is to make a slip when speaking from memory, I preferred to wait until I had verified my impression of what had been said and done. Hence this letter.

Mr. J. H. Paul, B.Sc., F.I.C., is personally well known to many engineers in connection with the supply of oxide of iron; and with him I have, from time to time, discussed points of interest in purification. I had spoken of a consequence which seemed to follow upon an increase above the normal quantity of oxygen present in the gas at the inlet of the purifiers—viz., a more rapid fouling of the lime by carbonic acid, or rather the quicker passage of carbonic acid from box to box—a condition of things which we had sometimes attributed to "slip" (a theory which had not satisfied me). Mr. Paul at once stated his opinion that at comparatively high purifying temperatures sulphurous acid would be formed, resulting in the expulsion of carbonic acid from carbonate of lime. He subsequently verified this theory in his laboratory at 120° Fahr. Here at Vauxhall we obtained a similar result at 115° Fahr.

Whatever credit may attach to the detection of the possible occurrence of this previously unsuspected reaction in the purifiers, is due to Mr. Paul, who, upon the facts made known to him, reached a theoretical conclusion which he confirmed by experiment.

A. F. BROWNE.

South Metropolitan Gas Company, Vauxhall, Dec. 3, 1903.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Monday, Dec. 7.

(*Before Lords Justices* VAUGHAN WILLIAMS, ROMER, *and* STIRLING.)

London County Council v. South Metropolitan Gas Company. The Sunday Gas-Testing Question.

This was an appeal by the defendants from the judgment of Mr. Justice Joyce, given on the 4th of May, to the effect that the word "daily," in the Gaslight and Coke and other Gas Companies' Acts Amendment Act, 1880, with regard to the testing of gas, meant "every day," and that consequently the plaintiffs were entitled to make testings on Sundays.*

Mr. WARMINGTON, K.C., Lord ROBERT CECIL, K.C., and Mr. LAURENCE ROSTRON appeared for the appellants; Mr. T. R. HUGHES, K.C., and Mr. T. T. METHOLD represented the respondents.

Mr. WARMINGTON, in opening the appeal, having stated the short point, said it was admitted that this was a new departure on the part of the plaintiffs, who still said they had a right to do what they claimed. It would be necessary to go shortly through the previous legislation on this matter, because his submission would be that a practice had grown up for a great number of years which should be taken into consideration in construing the Act of Parliament in question. The system of testing gas, so far as the Metropolis was concerned, was introduced in 1851; and in 1854 the local authority were empowered to appoint a practical Chemist for the purpose of testing gas both for illuminating quality and purity. This power was given with regard to one Company only, but was extended to all the Companies in 1860. In 1869, an Act was passed under which the defendant Company were incorporated; and it contained a number of clauses prescribing who should make the test, and how the tests were to be carried out. The learned Counsel read some of the more important clauses in this Act, the effect of which was that the Board of Trade were to appoint three competent and impartial persons who were called in the Act, and had subsequently been known as, Gas Referees. They were to prescribe and certify the mode, and the number of times of testing, both with regard to purity and illuminating power; and they were to prescribe what testing-places should be provided by the Company, and the apparatus to be used—both places and apparatus being under the control of the Metropolitan Board of Works. The Board were to appoint persons as Gas Examiners at the various stations; and a Chief Gas Examiner was to be appointed, and be removable, by the Board of Trade. The Examiners were to test at each place daily, and if the gas was ascertained to be defective in either purity or illuminating power, they were to forthwith give notice to the Company. The tests for illuminating power were to be made three times at least each day, at intervals of one hour; and section 33 provided that nothing in the Act should authorize the Referees to prescribe fewer testings. Section 36 provided that each Examiner should each day make a report of the result of his testings on the preceding day to the Board of Works, to the Chief Gas Examiner, and to the Company. The books kept by the Examiners were to be open to the inspection of the Company. Another section gave the Company a right of appeal from the Examiners to the Chief Gas Examiner. Section 3 of the Act gave the following definition of the word "day:" "The term 'day' means in this section twenty-four hours reckoned from 9 a.m. on one day to 9 a.m. in the forenoon of the next following day; so much of each day as is before 9 a.m. being reckoned as part of the immediately preceding day of the month or week." This Act made testing compulsory; and from that time until 1902 tests were taken on weekdays only, and the report made on every day—excluding the statutory day beginning at nine on Sunday morning and ending at nine on Monday morning.

* See "JOURNAL," Vol. LXXXII., p. 384.

In other words, reports were made on each weekday, but no tests were made on the Sunday. In 1876, there was another statute passed, which repealed a great many clauses of the previous Act, but substantially re-enacted them. Under section 30, the Company were to give to the Gas Referees and their clerks and assistants access to their works, with all facilities for the proper execution of their duties. By section 42, it was provided that the average of the testings throughout the day should be deemed to represent the illuminating power and purity on that day, with the proviso that if on any one day the gas supplied fell below the standard in either respect, the average of all the testings made on that day and on the preceding and following days should be deemed to represent the purity or illuminating power on such day. In carrying out this section, the practice had always been to treat Monday as the succeeding day to the Saturday; and a number of forfeitures had been incurred by the Company which would not have been incurred but for the fact that Saturday had been always treated as the day preceding Monday so as to make up the average.

Lord Justice STIRLING inquired if section 33 of the Act of 1869, which set forth that nothing should authorize the Referees to prescribe fewer testings, was repealed.

Mr. WARMINGTON said it was, and it was now left entirely to the discretion of the Referees. Coming to the last Act—that of 1880—there were only a few sections to which he need call special attention. The Metropolitan Board of Works were to be the authority; but it was admitted that the plaintiffs were the successors of the Board. Section 5 gave power to the Referees to visit the testing-places and examine the apparatus to see that it was in proper working order. They were also to prescribe and certify the mode to be adopted for testing; and the tests were to include pressure. There were the same provisions with regard to the average of testings and for an appeal to the Chief Gas Examiner. Sections 14 and 15 provided the penalties or forfeitures in case of deficiency; and in the Court below the list of forfeitures or convictions was put in. If Sunday was to be reckoned, it would have come in as one of the three days; but it was not—the Monday being held to succeed the Saturday. This list extended from 1879 down to the present time. He might say here, though he could not rely upon it as an authority, that one of the Gas Companies (not the present appellants), on being summoned under this section, raised before the Police Magistrate the very point that Friday, Saturday, and Monday did not give three succeeding days, and that therefore the certificate of the Gas Examiner, which was put in as evidence on which the Magistrate was to act, was not in proper form. The Magistrate did not take this view, but convicted the Company on the ground that Sunday had always been considered a *dies non*, and therefore the certificate was right. Now, the appellants contended that in this succession of Acts of Parliament dealing with the same subject-matter on so many occasions, it was right for the Court, in construing the Act, to have regard to the circumstances under which the legislation took place; and great reliance was placed on the statement of Lord Macnaghten, in an income-tax case argued in the House of Lords with regard to the words "charitable purposes," in which he said that the practice which had grown up of exempting as charities certain moneys which could be received, must be dealt with in view of the existing practice. It was the case of *The Commissioners of Income-Tax v. Hemsall* (Appeal Cases, 1891). Having read a portion of this judgment, the learned Counsel proceeded to say that in the present case they were not dealing with an Act passed in 1880 for the first time, but the latest edition of what had been the subject of enactment since 1869. There had arisen and continued a practice, first under the Metropolitan Board of Works and continued under their successors, whereby what he admitted was the *prima facie* meaning of the word "daily" was not strictly adhered to, but Saturday was taken as the day preceding Monday, and Sunday was treated as a *dies non*.

Lord Justice ROMER asked if Counsel contended that the Legislature must be supposed to have had notice of this practice.

Mr. WARMINGTON said he did. The Gas Referees were appointed by the Board of Trade, which was a Government Department, and they were to prescribe what the testings were to be.

Lord Justice STIRLING asked if the Referees were in any way under the control of the Board of Trade, or was it simply a nomination. Could the Board of Trade give them any directions?

Mr. WARMINGTON said they were appointed by, and were removable by, the Board of Trade; but he did not think the Board could give them directions.

Lord Justice STIRLING said the appointment was no doubt vested in the Board of Trade in order that there should be an impartial person to fill the office.

Lord Justice ROMER did not see what difference it made to Mr. Warmington's argument that the day omitted was a Sunday. Suppose the Referees had taken on themselves to have no tests on a Sunday, would it not be the same question? As far as he could see, it had nothing to do with Sunday. It might as well have been any other day in the week.

Mr. WARMINGTON thought there was a great difference between Sunday and another day.

Lord Justice ROMER asked why was it so for this purpose. Was there anything more sacred after 9 o'clock on Sunday morning than before 9 o'clock, or anything particularly sacred at 9 o'clock on the Monday?

Mr. WARMINGTON said this was ordinary labour which was required from the Gas Examiners.

Lord Justice ROMER said he supposed gas was supplied on Sunday.

Mr. WARMINGTON replied no doubt; but at present the appellants did not make gas on Sunday, except a very little in the morning. They asked that regard should be had to the practice which had grown up in construing the Act of Parliament.

Lord Justice ROMER: Supposing the construction of the Act is clear, do you say that the Act has been disregarded, and that ought to make us alter the Act?

Mr. WARMINGTON said he could not go so far as that. Lord Macnaghten did not stand alone in the view he had expressed. A similar statement was made in the Court of Appeal in the case of *Ewens v. Noakes* (50, L. J. New Series, p. 152), where there was a question whether a house which was inhabited by a caretaker and his wife and family was an inhabited house. For a considerable time, such a house had not been regarded by the Commissioners as an inhabited house; and in 1880, when it was brought forward, Lord Justice Thesiger, in construing the Act, said: "I do not think we should be justified in holding that the exemption would be less because the caretaker had his wife and family with him in the house." Then he especially referred to the habit that had grown up at the time the subsisting Act was passed. The exemption was for caretakers only; and the same principle applied in the present case. Never until 1902 had the appellants been asked to allow testings on Sundays; and they submitted that the practice was right, and that this must be had regard to in construing the Act of 1880. Then there was another point, which he must admit was not raised in the Court below—namely, that a special remedy had been supplied by the statute for the matter complained of; that this was the only remedy; and that plaintiffs here could not give them a declaratory decree. In 1871, the Act was passed to amend the Gas-Works Clauses Act of 1847, which was incorporated in the appellant Company's Act; and section 34 of this Act provided: "The undertakers shall give to the Gas Examiner and to his assistants, and to every local authority within the limits of the Special Act and their agents, access to the testing-place, and shall afford all facilities for the proper execution of this Act. In case the undertakers make default in complying with any of the provisions of this section, they shall, for every such default, be liable to a penalty not exceeding £5 to the local authority or to the persons making the application." It had been laid down in many cases that this Act of 1871 applied to the appellant Company. There was the case of the *South Metropolitan Gas Company v. Knox* (67, "Law Times," 556), where the Company were summoned for not supplying gas to a consumer who had given what it was said was reasonable notice under the Act of 1871. The Company then sought to evade liability on the plea that, by their Special Act, the consumer had to give a certain specified notice, which he had not done. But the Magistrate convicted the Company; and, on appeal, the case was dismissed. But there was another case—that of the Dudley Gas-light Company, where it was held that the Act of 1871 did apply to a Company whose Act incorporated the Gas-Works Clauses Act, 1847. His contention on that Act was this: There was not, in previous legislation, any provision for a penalty for not giving access and facilities; but under this Act this penalty was provided. Applying the well-known law that where a new offence was created or a new liability imposed, and the statute provided a special remedy or penalty, that and that only was the remedy to be pursued. He presumed he need not cite authorities on the point.

Lord Justice VAUGHAN WILLIAMS acquiesced.

Mr. WARMINGTON said he had frankly admitted that this point was not raised in the Court below; but it had also been decided in more than one case that such a point, which went to jurisdiction, could be taken at any time. In fact, such a point was taken in the House of Lords by the Lord Chancellor and the other Judges for the first time, and judgment given upon it. Here there was a special remedy given for a special offence; and he submitted that the only remedy open to the plaintiffs was to apply to a Court of Summary Jurisdiction for the infliction of that penalty. The third point, which, again, was not opened in the Court below, was that the London County Council were not the proper plaintiffs. But paragraph 11 of the Statement of Claim said that, under the direction of the plaintiffs, one of the Gas Examiners attended at each of the four gas-testing stations on Sunday, Nov. 2, 1902, but that the resident caretaker prevented him making the tests and the notification which, under the provisions of the Acts, it was his duty to make. His (Counsel's) submission was that the person so mentioned was not the servant of the plaintiffs, but of the Gas Referees. It was the Referees who had prescribed how and when the testings were to take place; and he submitted that they were the persons to whom the Examiner was responsible. It was for them, or probably for the Attorney-General, to move, and certainly not for the County Council. If the Examiner found difficulty in obeying the instructions given to him by the Referees, he might complain to them; but he could not complain to the plaintiffs, and give them a cause of action.

Lord Justice VAUGHAN WILLIAMS: The position you take up shows amply that you deny threatening, and continue to deny the obligation to allow the testing on Sunday. All that paragraph 1 prays is a declaration that that is wrong *qua* that it does not matter whose servant the Gas Examiner is.

Mr. WARMINGTON said supposing the defendants did, and threatened to do what was wrong, it did not follow that the County Council were the proper plaintiffs.

Lord Justice VAUGHAN WILLIAMS asked whether the contention on behalf of the appellants was that the Council had no right to interfere.

Mr. WARMINGTON said they could not, under section 7.

Lord Justice STIRLING asked whether section 36 was not material upon this point.

Mr. WARMINGTON said that that section related to "control." The Company could not interfere with the "control" by the County Council. Their only desire was that persons who under a statute had been appointed by the Council should perform certain duties at a certain time.

Lord Justice STIRLING: But your servants keep them out. What right have you to do that?

Mr. WARMINGTON said they did not interfere with the control. The Gas Referees had to prescribe when the testing should take place; the Gas Examiners came to the testing-place to test the gas on Sunday, and the Company's servants obstructed them.

Lord Justice STIRLING asked what right they had to do that.

Mr. WARMINGTON replied that testing was not prescribed, and could not be prescribed by the Gas Examiners.

Lord Justice STIRLING: There is a prescribed testing-place.

Mr. WARMINGTON said there was not, for testing. No test could be made by the Gas Examiners except as provided by the Referees.

Lord Justice STIRLING said he understood that the Referees had prescribed Sunday testing, whether rightly or wrongly.

Mr. WARMINGTON said that could only be done in accordance with the Act.

Lord Justice STIRLING remarked that the Act said "daily." Had the Referees given a direction in the words of the Act?

Mr. WARMINGTON admitted that they had.

Lord Justice VAUGHAN WILLIAMS said that if the appellants' construction of the Act of Parliament was right, they need not rely upon this point at all.

Mr. WARMINGTON acknowledged that this was so.

Lord Justice VAUGHAN WILLIAMS: If it is wrong, and the Referees have said "daily," then they have appointed someone to make these tests. If so, this particular station is a testing-station.

Mr. WARMINGTON said the Company only interfered with regard to testing on Sundays.

Lord Justice ROMER said if the County Council had "control" of the testing-stations, and the Gas Examiners were going there to inspect, they were doing between them all that was necessary, and it was the Company who would not allow the testing to go on. Then the County Council said the testing-station was under their control, and that they ought not to be disturbed; but the Gas Company said: "We will not permit the Gas Examiners to go there."

Mr. WARMINGTON said he had made his point, and he could not add anything further.

Lord Justice VAUGHAN WILLIAMS: You say the Act of 1847 is introduced into this Act, and that the word "daily" in the Act is constantly used as including Sundays.

Lord Justice STIRLING: And "daily" may, for many purposes, be construed as meaning each day.

Lord Justice VAUGHAN WILLIAMS: I am speaking of the definition with regard to the duty of the Gas Company. I think the section gives them the right to test every day, including Sunday.

Mr. WARMINGTON pointed out that the testing was not mentioned in the Act of 1847.

Lord ROBERT CECIL followed on the same side, and he was proceeded with his argument when the Court rose for the midday adjournment.

On resuming,

The appellants' case was concluded and that of the respondents opened. This was not finished when their Lordships rose. The further proceedings will be reported next week.

Opening Roads by Non-Statutory Gas Companies.

At the Fermoy Petty Sessions, on Monday last week, one of the employees of the Fermoy Gas Company was summoned for disturbing the surface of the road for the purpose of laying a service. The Company's Engineer and Secretary (Mr. R. Bruce Anderson, Assoc. M.Inst.C.E.) gave evidence to the effect that the nuisance complained of was transient and trivial. He characterized the action of the Local Authority as vexatious and frivolous, and asked the Bench either to dismiss the case or, if they felt bound to give a decree against the defendant, to inflict a nominal fine without costs. The Solicitor for the Local Authority asked the witness if, in event of the decision being in their favour, the road opening would be persisted in, in defiance thereof. Mr. Anderson replied that, without any intention to be discourteous to the Bench, the work of opening the road would be persisted in, if the safety or convenience of the public or the consumers called for it. The Bench (composed of five Magistrates) said they felt bound to reluctantly inflict a fine, which they did, to the extent of 1s., and the costs of the Court, amounting to 2s. 6d.; adding that the Local Authority could read between the lines as to what the decision meant. They had thus to pay their own costs.

Theft of Gas by a Bristol Tradesman.

At the Bristol Police Court on Friday, Edwin Langford, a nautical instrument maker, and one of the best-known tradesmen in the city, was summoned for stealing 100 cubic feet of gas, valued at 3d., the property of the Bristol Gas Company. Mr. Wetherby, who prosecuted, said Mr. Langford's business premises were at Broad Quay, and he resided at St. Vincent's Parade. At the latter address he had no fewer than 62 gas-jets, with an unusually large supply-pipe. On the 1st inst., complaints were made to the Company that there was an escape of gas at or near Mr. Langford's residence; and two of the Company's officials went to the spot at half-past eleven in the morning, and found the house closed. Knowing the defendant had business premises in the city, they returned at ten o'clock at night, when the house was still closed. Eventually they gained access by arousing two girls who were in a top room. One of the officials went in the dark to the place where the meter was situated, knowing its position well, and found that a piece of india-rubber tubing had been attached to the inlet-pipe, so that the gas would not pass through the meter. When Mr. Langford returned he made several excuses—first saying he was not using any gas, and then that he had only put in the tubing because the inlet-pipe was out of repair. Charles Eyers, one of the officials of the Company, stated that, with the number of jets in the house, the defendant could have burned 3600 cubic feet a day. With the heating and other appliances in use, the consumption would, of course, have amounted to a great deal more. The defendant gave evidence on oath, and stated his private residence was looked after by a housekeeper and her children. A complaint was made to him of an escape, and he found there was considerable leakage at the outlet of the meter. He turned off the gas at the main, and then found a leak in the outside pipe. He foolishly undertook to repair the defect. He did this on the 27th ult. He used very little gas, as he rarely returned from the city until after eleven o'clock at night; and he had given a general order that the gas should not be used in his absence. At the conclusion of the hearing, Mr. Weatherby said if the Bench had made up their minds to convict, he would call their attention to the fact that the accused was fined £10 and £5 costs for a similar offence in 1898. The Chairman of the Bench (Mr. Pembery) said the case before them was one of deception, and not of poverty. The accused would be sent to prison for six weeks, with hard labour, without the option of a fine.

MISCELLANEOUS NEWS.

THE LONDON COUNTY COUNCIL GAS-TESTING BILL FOR 1904.

The Parliamentary Committee of the London County Council will, at the meeting to-day (Tuesday), present the following report.

The Council on the 7th of July instructed us to obtain an amendment of the Gas Companies' Acts so as to obviate difficulties which had arisen owing to the Companies appealing against the Council's Gas Examiner's reports, and withdrawing the appeal after one month had elapsed, and it having been held in the case of *The Gaslight and Coke Company v. The Council*, decided in the King's Bench Division on the 31st of October last, that it was then too late for the Council to take proceedings. The Bill proposes (*a*) to allow the Chief Gas Examiner to decide an appeal in the absence of parties who do not attend before him after due notice; (*b*) to require the Company and the Chief Gas Examiner to give the Council notice should an appeal which has been lodged be withdrawn; (*c*) to make the time within which proceedings for breaches of the Company's Special Acts may be taken, six months (i.) from the date of the report of the Council's Examiner (which is made daily), or (ii.) from the date of the report of the Chief Gas Examiner, if an appeal be lodged and decided, or (iii.) from the date of the withdrawal of any appeal lodged and withdrawn. In connection with the preparation of the Bill, it was suggested that opportunity should be taken to insert a clause specifically repealing certain sections of the Gas (Metropolis) Act, 1860, which are no longer operative. We have made provision in the Bill for the repeal of sections 7 to 12, both inclusive, sections 25 to 34, both inclusive, and sections 37, 40, and 41 of the Act. We have been in communication with the Corporation of the City of London, which is the Gas Authority for its own area; and having been informed that that body acquiesce in the desire of the Council to obtain these powers, words have been inserted in the Bill to effect that object.

The Committee recommend "that the Bill be approved."

PUBLIC LIGHTING OF PADDINGTON.

Important Agreement with the Gaslight and Coke Company.

At the Meeting of the Paddington Borough Council on Tuesday, the Works Committee brought up an important report on the subject of the lighting of the borough. They stated that they had for some time had before them the questions, first, of transferring to the Gaslight and Coke Company the work of lighting the borough; and, secondly, the execution by the Company of the Council's scheme for increasing the number of lamps. The Borough Surveyor had submitted a report to a Joint Committee, composed of the Works, Electric, Gas, and Water Committees, in which he furnished particulars of his proceedings upon a resolution on this subject passed early in the year. He put himself in communication with the Company, and inquired on what terms they would be prepared to undertake the lighting of the borough. He first obtained the average number of each kind of lamp in use, and the respective total numbers and hours of lighting during the year 1902-3, and then asked for a quotation. The results based upon these prices are shown in the following table:—

	Actual Cost to the Council 1902-3.	Gas Company's Quotation.
Lighting and upkeep, &c.—		
(1) On the average meter system, as at present.	£8245 10 9 ..	£8639 18 3
(2) On the scale system	8043 15 4* ..	8447 18 3*
Replacement of knocked-down lamps, add.	29 18 0 ..	30 13 0
Replacement of parts beyond repair, add.	100 0 0† ..	Actual cost.
The following figures are included in the above prices relating to the average meter system:—		
Maintenance only of meters and boxes	201 15 5 ..	192 0 0
Maintenance, and provision, in addition, of new meters and boxes. .	221 15 5 ..	218 18 0

* These figures are based upon the assumption that the Company would charge for the same burners as were used during 1902-3 at rates based on the actual consumption of gas as registered by the meters, and not upon the theoretical consumption according to the rating of the governors. If the latter figures were adopted as a basis, some £200 would have to be added to the scale system total costs. † Estimated.

The Surveyor pointed out that it was obvious, from the figures, that the Council could execute the work of lighting the borough more economically than the Company. He explained that the £8245 10s. 9d. had been arrived at by deducting a number of items (which he specified), amounting to £3184 10s. 7d., from £11,430 1s. 4d., the total cost of the Lighting Department. With regard to the second question, the Surveyor obtained a quotation of £6243 10s., including a sum of £326 for the reinstatement of paving disturbed, which the Company required the Council to carry out themselves. The Borough Surveyor's estimate was £7200.

The Joint Committee came to the conclusion that it was not advisable to accept the offer of the Company to undertake the lighting and maintenance of the public lamps throughout the borough; but with regard to their offer to execute the Council's scheme for renewing the existing gas-burners and increasing the number of lamps, the Surveyor was instructed to negotiate further with the Company on certain points mentioned in his report, and endeavour to arrange for some agreement to be entered into with the Council's present contractors for the supply of fittings and castings. In pursuance of these instructions, the Surveyor had an interview with Mr. F. W. Goodenough, the Chief of the Gas Business Department of the Company, who had conducted the previous negotiations, with the object of obtaining some

further explanations in regard to their offer. These were duly furnished; and the Surveyor thereupon reported that the offer appeared to be one worthy of acceptance, if this course were possible without recourse to public advertisement. The Surveyor explained that the Company had arranged to obtain the great bulk of the goods required from the firm now holding the Council's annual contracts, so that no point arising out of the latter would interfere with the offer. The Company required that the whole scheme should be carried out at once, and not spread over a term of years. At the same time, they would accept payment by twelve quarterly instalments, each equal to one-twelfth of the total cost of the scheme, and make a deduction of 3 per cent. from their prices. If the work were paid for, on its completion, by one large sum, the discount would be 7½ per cent. This 3 per cent. discount represented a sum of £177 10s. 6d.; so that the total payment in respect of the scheme would be £6065 19s. 6d. The Committee pointed out that the acceptance of the Company's offer would mean a saving to the borough of upwards of £1000. They recommended as follows: "(1) That the Gaslight and Coke Company be informed that the Council cannot see their way to accept their offer to undertake the lighting and maintenance of public lamps throughout the borough. (2) That the Gaslight and Coke Company be informed that, subject to their entering into an agreement to be prepared by the Council's Solicitor, the Council do accept the offer, contained in their communications to the Borough Surveyor, to execute the Council's scheme for altering the position of certain of the existing gas-lamps, and increasing the number of gas-lamps in the borough." The recommendations, the scope of which was indicated in our Editorial columns on the 24th ult., were adopted without discussion.

A LOWER ILLUMINATING POWER GAS FOR LEEDS.

An important proposal by the Gas Committee was adopted at the meeting of the Leeds City Council last Wednesday. It was to the effect that the Parliamentary Committee be requested to insert in the Consolidation Bill a clause fixing the standard illuminating power of the gas at 16 candles, tested with an argand burner having 24 holes and a 6-inch chimney.

Moving the adoption of the minutes containing this resolution, Alderman Lowden stated that similar action had been taken by many gas concerns throughout the country. At present, 398 corporations and companies were supplying 16-candle gas or under—notably Birmingham, Huddersfield, Sheffield, the Gaslight and Coke Company, Newcastle-on-Tyne, Peterborough, Salford, Wakefield, and York. Among the 167 towns supplying 15 candles were Nottingham and Leicester. Fifty corporations and companies were supplying the low standard of 14 candles, including the South Metropolitan Gas Company. It had been suggested that Leeds should ask for a 14-candle standard; but he had not the courage to propose such a reduction on this occasion. The undertakings giving this standard had asked for power to do so because the coal which they used would produce that quality of gas. The circumstances in Leeds, however, were different. With Yorkshire coal, it would be difficult to produce gas of a standard less than 16 candles. In asking the Council to adopt 16 candles, he felt he was taking the right course, and a course which had commended itself to the majority of the Gas Committee. The original Act specified 16 candles tested with an argand burner having 15 holes and a 7-inch chimney; but the 15-hole burner had become obsolete, and had been disregarded for a long time. The proposed standard was 16 candles, tested with an argand burner having 24 holes and a 6-inch chimney. The 24-hole or "London" argand burner was the only standard burner for testing 16-candle gas throughout the country. It had been proved that 16-candle gas used with an incandescent burner was as efficient as 18-candle gas when similarly used. Sixteen-candle gas used with a special burner would give within 3 per cent. of the efficiency of 18-candle gas with the same burner; and 16-candle gas used with a special burner would give practically as good results as the present 18-candle gas with the burner ordinarily used. It would be no disadvantage to a consumer who had incandescent burners to supply him with 16-candle gas. On the other hand, he would at once reap two great advantages. In the first place, 3½ cubic feet per hour would suffice, instead of 5 cubic feet; and, secondly, there would be a reduction of price, following the adoption of the 16-candle standard. What, it might be asked, about consumers who used the ordinary flat-flame burner? The General Manager (Mr. R. H. Townsley) and his staff had recently made numerous tests, and had made a discovery of great importance—that 16-candle gas used with a special burner would give within 3 per cent. the efficiency of 18-candle gas used with the present burner. Tests had also been made by Mr. Buckley, the Magistrates' Inspector; and his results were actually better than those which had been obtained by the staff of the Gas Department. In asking the Council to consent to the reduction of 2 candles, the Committee believed they were pursuing a course which would be a decided advantage—a less consumption and a reduction in price.

It was suggested by Mr. Wilson that the figure should be altered to 14 candles. Dr. Hawkyard moved, as an amendment, the omission from the minutes of the resolution bearing on the reduction of the gas standard, on the ground (as he put it) that the consumers were only getting 14 candles at the present time. He wanted further information from other towns, and deprecated any undue haste in such an important matter. He was sure that the public would resent any reduction. Mr. Henry seconded the amendment, observing that if they allowed the standard to be fixed at 14 candles, they would get gas of 10-candle power.

The minutes were adopted by a fairly large majority.

It is reported that an amalgamation of the Weardale Steel, Coal, and Coke Company, Limited, and the South Durham Iron and Steel Company, Limited, has been arranged. The two concerns are the most important in the North of England steel trade.

THE "SELAS" LIGHT AT ST. ALBANS.

By the courtesy of Messrs. Nicholson and Co., of St. Albans, and Mr. A. F. Phillips, several gentlemen interested in local affairs were, on Monday of last week, permitted the opportunity of witnessing the initiation of the "Selas" system of gas lighting, which has been adopted throughout the Beaumont Works. To Messrs. Nicholson belongs the credit of being the first firm in England to adopt the light; the installation having been inaugurated by Mr. Phillips with the personal supervision of Herr Raap, the inventor—the cost incurred being about £195. The comments of those present upon the results obtained were highly favourable. A small belt attached to the ordinary gas-engine used for driving the machines in the works provides the motive power. As already mentioned, the system has been adopted throughout the works. There are 77 burners of 100-candle power, yielding about 7700 candles, and one burner of 1000-candle power, or a total of 8700 candles. This amount of illumination is said to be produced at a cost of 9d. per hour; and to obtain the same light at the same cost by electricity, it would be necessary to procure it at 0·267d. per unit. The system was fully described by Mr. F. D. Marshall in a paper read before the last meeting of the Institution of Gas Engineers (see "JOURNAL" for June 16, p. 790); but the following comparison of cost, which appears in the "St. Albans Times," will doubtless be of interest: "With an ordinary gas-burner of the best kind, 3 candles may be obtained with a consumption of 1 foot of gas per hour. With the Welsbach incandescent gas-burner, 20 candles may be obtained with a consumption of 1 foot of gas per hour. With the 'Selas' system of high-pressure gas and air, with the incandescent gas-burner, 40 candles may be obtained per foot of gas consumed per hour. With the incandescent electric light, 3½ watts are required for each candle. Therefore, assuming 1000 candles are required, and the price of gas is 3s. 4d. per 1000 feet, and electricity is supplied at 6d. per unit, the comparison would be as follows: Ordinary gas, 330 feet, 1s. 1¼d.; Welsbach incandescent lighting, 50 feet, 2d.; 'Selas' high-pressure gas, 25 feet 1d.; and electric lighting, 3500 watts, 1s. 9d. So that, by the 'Selas' system, light is produced about 21 times cheaper than by electricity."

PREPAYMENT METERS AT BELFAST.

The Belfast Gas and Electric Committee have decided upon the adoption of prepayment meters; and it is hoped that the system will be in working order at the beginning of next month. Inquiries are now being made as to which are the best meters for the purpose; and it is intended that Mr. William Taylor, who is at present Senior Inspector, shall take charge of the new branch. The Committee have arrived at this decision on the matter after consideration of a report prepared by the Chief Inspector (Mr. Cleland) and the Indoor Collector (Mr. Andrews). In the course of this report, the following interesting calculation is made as to the results that may fairly be anticipated from the adoption of the system: In 1900, the occupiers of 1655 houses, with rents varying from 3s. per week to £22 per annum, consumed 15,149,100 cubic feet of gas, of a total value of £1704 6s. 10d., equal to 9153 cubic feet, or £1 0s. 7d. per consumer per annum. Assuming that the proportion between prepayment consumers and ordinary consumers will ultimately be 1 to 5, and that the ordinary consumers increase at the rate of 2000 per annum, the estimated number of the latter at the end of the year 1909 will be 56,000, and the number of prepayment consumers 11,000—making a total of 67,000.

DONCASTER'S APPLICATION TO PARLIAMENT.

Gas and Water Extensions.

A Special Meeting of the Doncaster Town Council was held last Tuesday for the purpose of considering the proposed application to Parliament for extended powers with regard to their gas, water, and electricity undertakings, and other purposes.

The Town Clerk (Mr. R. A. H. Tovey), in explaining the measure, dealt first with the gas supply. He said that in the year 1858 the Corporation took over the undertaking; and since the purchase, they had extended the supply to the outlying districts of Balby, Hexthorpe, and Wheatley. They had done this for nearly fifty years without statutory powers; and, strictly speaking, they had no legal right to supply gas in the way they were doing. Notwithstanding this, they had a very amicable arrangement with the parishes; and there had been no difficulty in carrying out the undertaking. During this period, the Corporation had spent large sums from time to time on improvements to the works and extending the mains. These sums, and also practically the whole of the large capital expenditure, had been paid off out of revenue derived from the works. The time had arrived when the Corporation felt that they were not entitled any longer to spend such large amounts of capital out of revenue. It had been found necessary to improve the present retort-house and gas-works machinery; and this would involve a large outlay, some of which had already been incurred. The prospect in the future of more gas being required owing to the growth of the area, had caused the Committee to feel that they should put the undertaking as a whole on a statutory basis to obtain improvements in dealing with emergencies, and which would remove the burden from the present generation—that they should not have more than their fair share to pay of the money spent. They also took the opportunity of extending their powers, not only in the borough, but the outlying districts, and of legalizing what they had already done. With respect to electricity, they had at present full statutory powers for everything they had done; but in consequence of inquiries made from time to time from Wheatley, Balby, and Hexthorpe, they felt that the time had arrived when they should be able to supply other districts with ordinary commodities, which, owing to their size, they

were not able to obtain for themselves. For this reason, it was intended to ask for the extension of the provisions already granted under their Electric Lighting Order. The water supply was governed by the Act of 1873, promoted by the Corporation. The area had grown, however; and it was proposed to supply other townships. It was found compulsory to spend further sums on the undertaking. The minerals which lay beneath the reservoir and its banks had not been purchased; and danger was apprehended owing to the near approach of the workings of one or two collieries. The Corporation had given notice to the owners to treat for a contract whereby they would have to cease working the coal in that direction. This would involve the expenditure of some £12,000 or £15,000. When Doncaster commenced to take water from the Sheffield Corporation, they were bound under the Act to take and pay for at least a million gallons per day. This supply, and the additional water taken from their Thrybergh reservoir, would meet the requirements of the present generation, and, he believed, would be sufficient for a long time ahead. The pipes from Thrybergh to Doncaster were not able to convey any more water should the demand be increased; and it was proposed to lay a further line of mains from Thrybergh to the service reservoir at Warmsworth, which would make the latter reservoir able to supply twice or three times the present amount. It was estimated that the extensions and improvements to the gas-works would cost £40,000; and this included the extension of mains from time to time, as required, over a considerable period. The water-works extension would cost £45,000, inclusive of the sum needed to purchase the underlying minerals. The expenditure on the electricity undertaking was not included in the Bill, as the Order which they already had gave them the necessary powers. It was the intention of the Council to supply gas and electricity to the outside authorities at the same cost as in the borough.

On the motion of the Mayor (Mr. J. T. Spencer), it was unanimously resolved that the Bill should be promoted.

SOUTHPORT AND THE GAS SUPPLY OF BIRKDALE.

Local Government Board Inquiry.

At the Southport Town Hall on Wednesday the 25th ult., Major C. E. Norton, R.E., opened an inquiry, by direction of the Local Government Board, into an application by the Southport Corporation for power to extend the borough by the inclusion of Birkdale.

Mr. Balfour Browne, K.C., Mr. Marshall Hall, K.C., and Dr. Davies Williams represented the Corporation; Mr. Wedderburn, K.C., and Mr. Hutchinson appeared for the Birkdale District Council. Other parties were also represented.

In the course of the first day's proceedings,

Mr. *George Lloyd*, the Borough Treasurer, stated that the debt of Southport was £943,530; while that of Birkdale was £50,000. With regard to the supply of gas to Birkdale by the Southport Corporation, 8d. per 1000 cubic feet of gas supplied was paid by the Corporation to the Birkdale District Council, under section 43 of the Act of 1871. It was a statutory charge, and had been called a "rebate." There was an express engagement that the Corporation should pay the Local Authority 4½d.; and to the Birkdale private consumers, in consideration of the power conferred, they were to pay a further 3½d. This was how the total was made up. One amount was for the use of mains, and the other for the right of supply. They had also the power to charge outside their area 6d. per 1000 cubic feet more than inside. The population of Southport was close upon 50,000; and their debt was twenty times that of Birkdale. With reference to the Southport, Birkdale, and West Lancashire Joint Water Board, Southport guaranteed four-fifths and Birkdale one-fifth. If Birkdale were incorporated with Southport, there would be only one guarantor.

Mr. *G. F. Travis*, a member of the Corporation, said the undertakings carried out by the Southport Corporation included the gas-works at a cost of £265,386, and electricity works costing £172,382. The gross profit on gas was £22,236; and on electricity, £12,363. In an agreement drawn up between Southport and Ainsdale (the Parish Council of which had since agreed to join Birkdale), Southport offered that the price charged for gas should be the same as in the borough from the date of incorporation. Subsequently, the Ainsdale people made other arrangements with Birkdale. The terms offered to Birkdale by Southport included the following clause: "At no time from the date of incorporation shall the Corporation rates in Birkdale for a period of ten years exceed 2s. 6d. in the pound for all purposes which have been covered by the general district rate in Birkdale up to the 31st of March, 1903: Provided that rates to cover the charges for police, education, library, and cemetery purposes, and any deficit under the Southport Water (Transfer) Act, 1901, shall be in addition. The price to be charged to consumers for gas in the township of Birkdale shall during such period continue to be in the same ratio as at present to that charged to consumers in the existing township of Southport. At the end of such period of ten years, the rates and the price charged for gas shall be the same in Birkdale as in Southport." He estimated that a saving of at least £2500 per annum could be effected as a result of the amalgamation of Birkdale and Southport in respect of the water undertaking alone.

Mr. Wedderburn (in cross-examination): What would Birkdale gain in the matter of gas by the proposed union?

Witness: They would get their gas at 6d. per 1000 cubic feet less.

Southport would gain 2d. per 1000 cubic feet?—No. If we drop the price of gas 6d., we shall lose all the revenue of that gas.

In further cross-examination, witness said the deficit on the Water Board was £7000. If they reduced the price of gas, they would lose £900. The present price of gas in Southport was 2s. 8d., and in Birkdale 3s. 2d.—less 5 per cent. in each case.

Mr. Wedderburn: I am told the deficit on the Water Board is £8000 at the present time.

Mr. Wedderburn said the desire of Birkdale was not to amalgamate. He pointed out that when the Southport Water Bill was applied for, it was not stated that within two years there would be an application from them to swallow up Birkdale, which formed part of the Water Board's area. Now they wished to say: "Because you have become a partner, you have ceased to exist." At present the Birkdale and West Lancashire representatives on the Water Board could control reckless expenditure on the part of Southport; but if amalgamation took place, the balance of power would go, and Southport would be predominant. There would then be no West Lancashire and no Birkdale control. He also held that, on the question of the gas supply, there was no ground for annexation.

Mr. Marshall Hall said there was a community of interests between Birkdale and Southport on both gas and water questions. They would have one efficient system in regard to the gas and the gas-mains if they were to be incorporated; and there would be no real increase in the rates of Birkdale when the true facts were considered. The liquidation of the net debt, and interest thereon, of Southport, amounting to £943,000, after taking into account the profits and income of the remunerative undertakings, cost the ratepayers only a rate of 5d. in the pound; whereas the cost to the ratepayers of Birkdale to liquidate its debt was a rate of 1s. 3½d. in the pound. Or, granting them the profit of 6¾d. per 1000 cubic feet of gas sold in Birkdale—6d. of which had been charged on the gas consumers, and collected by the Corporation in order to hand over to the Urban District Council—even then a rate of 8¾d. was required to meet their debt against Southport's 5d.

The inquiry then closed.

PROVINCIAL RATES AND GAS, ELECTRICITY, AND WATER CHARGES.

We have received from Mr. James Carter, the Borough Treasurer of Preston, a copy of his tabulated statistics of the rates levied and collected, and the charges made for gas, electricity, and water, in a number of provincial towns, for the year 1903-4. There are 83 places in all—being seven more than those in last year's list (noticed in the "Journal" for Dec. 23, 1902). The new-comers are: Bolton, Bacup, Hastings, Kensington, Oxford, Stalybridge, and Westminster. The populations range from 702,195 (Liverpool) down to 20,288 (King's Lynn); the rateable values being highest in Westminster, £5,505,223—Liverpool and Manchester coming next with £4,305,767 and £3,532,321—and lowest in Stafford, £77,751. The places most heavily rated are West Ham, 10s.; Norwich, 9s. 5d.; Wolverhampton, 9s. 3d.; Rotherham, 9s. 2d.; East Ham, 9s. 1d.; and Wakefield, 9s. Those which have the lightest rates are Newcastle, 4s. 9d.; Oxford, 4s. 6d.; and Lancaster, 4s. Out of the rents of property and profits transferred from municipal undertakings, Darlington returns the rates to the extent of 1s. 8d. in the pound; Wigan coming next with 1s. 6½d.; and Carlisle with 1s. 5d. Darwen figures for ⅝d., Eastbourne for 0·8d., Bacup for 0·9d., Bournemouth for 0·95d., and West Hartlepool for 0·6d. The highest net charge per 1000 feet for gas is at King's Lynn, 3s. 6d.; the lowest at Widnes, 1s. 4d. (average). Other towns in which the charge is less than 2s. are Bury and Sunderland, 1s. 11d.; Gateshead, 1s. 10½d.; Plymouth, 1s. 9d.; and Newcastle, 1s. 7·6d. The rates for electricity range from 8d. (Darlington) down to 3¾d. (Liverpool) per Board of Trade unit. The charge for water for domestic purposes on a house of £15 rateable value is still highest at Bury and Rochdale, 2s. in the pound; Ashton-under-Lyne coming next with 1s. 11d. It is lowest at Southampton, 6d.; King's Lynn, 6½d.; Liverpool, 7½d.; and Manchester, 8d. The other places in which the charge is less than 1s. in the pound are Birkenhead, Bootle, Brighton, Bournemouth, Kensington, Leamington, Lincoln, Oxford, Plymouth, Reading, Salford, Westminster, Widnes, and York. At Preston (Mr. Carter's own town), the total rates are 8s. 5d. in the pound; and they are relieved to the extent of 8½d. by the rents of property and the profits transferred from the gas, water, and other undertakings. The price of gas is 2s. 11½d. per 1000 cubic feet; of electricity, 7d. per unit; and of water, 1s. in the pound on £15 houses.

INCANDESCENT GAS IN CANTERBURY CATHEDRAL.

Canterbury Cathedral is one of the latest converts to incandescent gas lighting, which has now become such a popular system of illumination for places of worship. In competition with the electric light, the Canterbury Gas Company recently secured the lighting of a special stand in the nave for an Oratorio, which was done by means of four clusters, each containing three No. 4 Kern burners. In addition to this, Kern burners were, for the occasion, fitted throughout the whole of the nave; and the effect was so striking that the Dean and Chapter decided to retain the burners already fixed, and to extend the incandescent light throughout the cathedral, including the great choir—the music desk and keyboard of the organ being lighted by two incandescent lights previous to the Oratorio. In the body of the nave there are eight three-armed brackets, on which are fixed No. 3 Kern burners—24 in all—and on the steps leading to the choir two No. 4 Kern burners have been placed on existing standards. The Company have now received orders to fit up part of the choir itself with No. 4 Kern burners on existing standards; and the balance will be lighted by means of special brackets fixed to the pillars. Some 50 No. 4 Kern burners will be fixed in the choir when the work is completed. Part of the East transept is already lighted by a bracket containing three No. 4 Kern burners. All the burners are fitted with the plain obscured (or sand blasted) globes supplied by the Welsbach Company for church lighting. A 750-candle power Lucas lamp has also been erected to light the entrance yard and gates of the cathedral and the entrance to the Archbishop's Palace. Much credit is due to Mr. H. C. Page, the Company's Engineer, who, with the assistance of his Outside Superintendent, Mr. Donaldson, has successfully secured this order—especially in view of the fact that electric lighting was being seriously considered by the Cathedral authorities.

WATFORD ELECTRIC LIGHT UNDERTAKING.

Proposed Sale to a Company.

A report of the Electric Light Committee which was considered at last Thursday's meeting of the Watford Urban District Council recommended that "application be made to the North Metropolitan Electric Supply Company to ascertain whether they would be prepared, and if so on what terms, to acquire the electric lighting undertaking of the Council, and to supply the district of the Council with electrical energy."

In the course of the very long discussion which took place upon the subject, Mr. Benskin said his own opinion was that it would be a very great pity to do as the Committee proposed; it would show a very poor spirit. Nearly every town in England of the same size as Watford was only too anxious to have an electric light scheme in its own hands; and this showed there was a feeling either that under private monopolies consumers were subjected to all sorts of vexatious charges, or that there were certain benefits accruing to the possession of these monopolies. The figures for the year ending March 31 last were: Receipts, £5844; expenditure, £4887; instalments of principal and interest, £2540—leaving a deficiency of £1580. He complained of the hastiness of the Committee. They might have waited until next month, when they would have known the result of the present year's trading. He was informed the estimate would be realized; and they had already passed eight months of the year. The estimate was: Receipts, £6600; expenditure, £4200; interest and repayment, £3300—leaving a deficiency of £900. In February of each year, it was usual to make an estimate for the following year. They were not able yet to make this estimate; but at the same time he ventured to say that, inasmuch as next year there would only be an addition to the capital expenditure of £90, if the business increased in the same ratio as it had done during the last two years, on March 31, 1905, there would practically be an equilibrium between the receipts and expenditure and the paying off of capital and interest. Mr. Longley remarked that he and others, six or seven years ago, asked the Council to call a meeting of the ratepayers with a view to selling the Provisional Order to a private company. Everyone would admit now that if this had been done they would not have had the loss they had had during the past two or three years. He did not wish to cry "Stinking fish;" for he was as anxious as any member to make the light or anything else that they took in hand pay. Mr. George pointed out that each connection cost the Council £11, and many of those who had the connections were not using the light at all. At present, 105 out of 290 connections were under £1; so that nearly half their business was carried on at a loss. The total loss really on the light was £2600. He was not an electrician, but looked at the matter from a commercial point of view. There was nothing large about the business except the loan of £58,000. Many shopkeepers with £1000 capital made a larger return than they did with the light. Their actual business done was represented by £2271; and did they suppose that on this the undertaking could be made to pay? The depreciation on electric light plant was very marked. Dr. Robbins said that what struck him most was the fact that the cost of production of their light per unit was the highest, with the exception of one, in the whole of the United Kingdom. Then he compared their wages and management expenses with other places where electricity had been run successfully; and he found their wages were much higher, and their management expenses were also higher. Further, he found that they were supplying more units for the public service as compared with the amount supplied to other people; and to these three items were due the loss they made. Mr. Thorpe thought it would be a great pity to sell the undertaking; and that it would be quite possible for them "to pull it through." Mr. Ellis pointed out that the amount expended on the undertaking up to the present time was about £58,000. Now it was suggested that they should borrow another £25,000. Had anyone thought of that? The capital would be £83,000, and they had to pay for this 3½ per cent. Thus, to pay the interest alone on their borrowed capital, they must make a clear profit of £3000 a year. Was there any earthly prospect of the electric light increasing to this extent? Before they touched a halfpenny themselves, they must make a profit, roughly speaking, of £3000 a year. If they were to secure any profit for themselves—say, only 3 per cent.—they must make a profit of £6000 a year. What chance was there of their receipts going up to this extent? It seemed to him that, with a capital of £83,000, they ought to expect to make a lot more profit than what would merely provide the interest on the loan; and he did not think it worth while the Council speculating these enormous sums of money for, perhaps, a paltry 2 or 3 per cent. Would any business man consider 3 per cent. on the capital outlay a sufficient return?

Mr. Neale moved, and Mr. Southern seconded, that the report be not adopted; but after a further considerable amount of discussion, this amendment was lost by six votes to eight, and the Committee's recommendation to seek an offer for the undertaking was carried.

Manchester Corporation and the Supply of Gas Heating-Stoves.—One of the matters considered at last week's meeting of the Manchester City Council was a resolution moved by Mr. Abbott—"That it is desirable that the Gas Committee consider and, if practicable, provide and grant such facilities as will enable householders to obtain gas-fire stoves suitable for living-rooms from the Committee by an arrangement similar to that made for the use of gas cooking-stoves." Alderman Gibson, the Chairman of the Gas Committee, said there was nothing very objectionable about the proposal; but it was not a new thing at all. The Gas Committee were not philanthropists; but they were adopting methods that would increase the consumption of gas. As the result of the gas-cookers being so freely used, they had increased the consumption during certain hours of the day by 25 to 30 per cent. They did not let heating stoves on hire; and in any case they would rather that those who used them should help private enterprise. The resolution was defeated by a large majority.

METROPOLITAN WATER ARBITRATION.

(*Before the Right Hon. Sir* EDWARD FRY, *Sir* HUGH OWEN, G.C.B., *and Sir* JOHN WOLFE-BARRY, K.C.B.)

Twentieth Day—Friday, Nov. 27.

Lord *Rothschild* was the first witness to-day.

Mr. BALFOUR BROWNE: You gave evidence in the East London case with reference to the capitalization of a secure water income?

Witness: Yes.

In this case, the New River Company are not to be paid in cash, but in water stock; and I want to ask your opinion as to the probable value of the Water Board's stock?—I do not think it is possible to speak with certainty as to what the value will be in July next. The value of the stock, if I may be allowed to say so, will depend upon a great many circumstances. If, as I assumed on the former occasion, the shareholders of all the Companies were to be paid in stock, that would have increased the value of it; but as it appears probable now that the great majority of the shareholders will be paid in cash, there must be a large issue of the loan. This will depreciate the value of the stock for a long time, and would inflict an injury on the shareholders of the New River Company if I were to make the same assumption that I did before. I think I am accurate in stating that the County Council stock at the present moment is in the neighbourhood of 93; and if there were a large issue of stock, the price must fall. Therefore, in determining the value of the stock to be given to the shareholders of the New River Company, you would have to fix the rate certainly lower than 93—I will not say very much lower, but lower than 93—for otherwise you would be inflicting an injury in respect to a stock which did not represent the value to which they were entitled. If all the Companies were paid in stock, it would not perhaps be necessary to take so low a price, because every shareholder receiving his stock would have made a market for it, and probably increased its value.

The PRESIDENT: You said somewhere about 93. Can you tell us what figure you put it at?

Witness: If there were no other issue of municipal loans between now and July, I would put it at 91 or 90; but as there is a probability of the Council appealing for a large sum of money soon, and as there are some loans on the market, it is difficult to say. If you ask me now, I should say 90.

Mr. BALFOUR BROWNE: If, for instance, the Irish land stock was coming on the market before the issue of the water stock, might it not go even below 90?

Witness: I do not wish to compare the value of that stock—a purely Government stock—with municipal stock.

Mr. *C. J. Whittington*, a stockjobber, examined by Mr. CRIPPS, said he agreed with the evidence of Lord Rothschild—that the probable price of issue of stock at the present moment would be 90.

The Hon. *L. A. Brodrick*, examined by Mr. BAGGALLAY, said he was aware that the holders of the New River Company were to be paid in Water Board stock.

Mr. BAGGALLAY: Assuming it to be a 3 per cent. stock, what is the probable price at which it would be issued six months from now?

Witness: It depends on a great variety of conditions. It is difficult to forecast; but taking everything into consideration, particularly the amount of stock issued, I should put it below 90—probably 87.

In cross examination by Mr. MOULTON, witness said the price of issue was settled usually almost at the last moment.

THE QUESTION OF THE LAND-TAX.

The PRESIDENT said the Court would now proceed to deal with the matter of the land-tax. The question they had to decide was whether the payments for land-tax made by the Company over a series of years were made by them on account of the undertaking, or whether they were made by them on account of the several owners of the shares in the undertaking—in other words, was the liability to pay the rental in the land-tax on the undertaking as a whole, or was it on the owners of shares in the undertaking. The matter had been argued under Act 38 of George III.; and the question, in their opinion, depended clearly and almost exclusively upon the true construction of section 57 of that Act (cap. 5), from which it was obvious that the person charged was the person who had a share, and the charge was not upon the profits of the shares but on the value of the shares. This was a very distinct enactment—that the liability rested upon the owner of the share. The statute went on to provide that the Governor or Treasurer of the New River Company should make that payment to the collector of the land-tax, but that it must be made on behalf of the person who was charged with it—that was, the owner of the shares; and, accordingly, a deduction was made on behalf of the shareholders from the next dividend payable to the shareholder. Then there was a provision with regard to distress, which was perhaps rather a peculiar one, because it enabled the receivers (the collectors of land-tax) to levy the amount remaining unpaid upon the property by distress or sale of goods and chattels jointly belonging to them or held in trust for the persons who should have such shares. Therefore, where there was a refusal to pay the land-tax charged upon more than one share in the undertaking, the distress might be levied upon the property jointly belonging to the shareholders. A subsequent statute of the same year of George III. provided for the redemption of the land-tax; and this redemption was exercised. It appeared to the Court that these payments were payments on the part of several shareholders, and not on behalf of the undertaking. The conduct of the Company had been in exact accordance with their decision. The Company had paid these sums, and received such portions of the land-tax as were not redeemed, and they had treated them as not on behalf of the undertaking, but the respective shareholders. They therefore declared that, according to the true construction of the Act 38 of George III., cap. 5, the sums paid by the Company for land-tax were payments not made on account of the Company, but on account of the several owners and shareholders of the undertaking, and that these payments were not expenses of the Company. This declaration would, of course, affect

two items—it would affect the item which the Company were now seeking to have added to their claim, and the item of rates and taxes.

Mr. BALFOUR BROWNE said the words used were that the payments were not expenses of the Company; and yet the Court enacted that this would involve an adjustment both of their rates and taxes as claimed, and also the claim to the land-tax.

The PRESIDENT: You claimed a sum for redeemed land-tax.

Mr. BALFOUR BROWNE: We claimed it because it was not an expense of the Company.

The PRESIDENT: We say you are not to claim this, because it is a sum you paid on behalf of the shareholders.

Mr. BALFOUR BROWNE: We did not claim it; we only deducted it from the expenses, because it was not an expense of the Company. If your decision is that it is not an expense of the Company, it is a decision in my favour.

The PRESIDENT: The meaning of the Court is this: What you claimed for land-tax was a payment on account of the liability of the shareholder, which you are entitled to recover from him by deduction from the next dividend.

THE STAINES RESERVOIRS.

After a legal argument as to procedure in regard to the Staines Reservoirs Joint Committee expenses,

Mr. MOULTON said that his position was that, although the Staines reservoirs were managed by a Joint Committee, they were managed by the Committee solely on behalf of three Companies equally (the New River, the Grand Junction, and the West Middlesex Companies), and that they had, under the Staines Reservoirs Act, taken the joint liability for maintaining the reservoirs, and that this must be regarded like any other liability—an actual liability on the Company. In that case, it became necessary to find what the revenue liability of the Staines reservoirs undertaking was. Broadly speaking, he might say that it had no revenue, but its expenses were borne by the Company. It became absolutely necessary to ascertain what were the expenses. He did not find fault with the expenses of 1902; but they had to forecast the revenue of the Company in the future, as this would be a deduction from that revenue. The liability to meet the expenses of the Staines reservoirs was an immediate one. Their undertaking was to be valued subject to that liability; but the sinking fund did not arise until a date defined by the statute. Counsel went into the facts concerning the reservoirs and the construction expenses, and said he proposed to call evidence as to the facts.

Mr. CRIPPS objected at this stage, on behalf of the West Middlesex Company, and said the sinking fund did not arise in their case, and they knew it did not also in the case of the New River Company.

Mr. BALFOUR BROWNE said that, according to the intention of the Act, the sinking fund had not come upon the New River Company at all. He denied absolutely that the water-works, either the aqueduct or the reservoirs, were in such a condition as to mean extra cost of maintenance.

Mr. *R. E. Middleton*, examined by BALFOUR BROWNE, said that, in conjunction with Mr. Hunter, he was one of the Engineers for the Staines scheme. The first water taken into the reservoirs by the Contractors was in May, 1902. If there was any leakage from the conduit, the Contractors were bound to make it good at their own cost.

Mr. BALFOUR BROWNE: Have any of the three Companies obtained a drop of water from the Staines reservoirs as yet?

Witness: No. The New River Company cannot get a drop until the conduit is completed; and that will take about a couple of years.

In cross-examination by Mr. MOULTON, witness said the Contractors had to be responsible for the reservoirs being water-tight—not beyond that. The whole of the cost of filling the reservoirs would be borne by the Joint Committee, including the cost of the water; but he did not say that the water belonged to the Joint Committee.

Mr. *Walter Hunter*, Engineering Director of the Grand Junction Company, and one of the Engineers of the Staines scheme, also gave evidence, and said he had every reason to be satisfied with the way the Contractors had carried out the work. It had been done admirably, with the exception of one defect in a portion of the wall, which they had made good.

Replying to Mr. MOULTON, witness said that if Counsel stated that there was power for the New River Company to take the water by other pipes than their own before two years, he would accept it.

Mr. MOULTON called Sir *A. Binnie*, Mr. *J. Watson*, Mr. *G. F. Deacon*, Mr. *J. Parry*, and Mr. *E. B. Taylor* to give evidence as to the state of the aqueduct and reservoir, which they regarded as unstable and defective; and Sir *A. Binnie* stated that the whole thing would be broken up in about twelve years.

Mr. CRIPPS said the West Middlesex Company reserved their position in this matter, as they had had no notice of the point being raised, and he was not ready at present to deal with it.

Mr. BALFOUR BROWNE also complained that he had been taken by surprise.

The PRESIDENT said Mr. Moulton had indicated it quite plainly; but the Court would not like to shut the parties out from evidence, and they must be ready by Monday morning.

The Court then proceeded to give their decision upon the question of the sinking fund in connection with the right to take water from the Staines reservoirs by the Joint Committee.

The PRESIDENT said they were prepared to say that, according to the proper construction of the Act of 1896, the water had not as yet been obtained by means of the works by that Act authorized within the meaning of the section. According to their view, the sinking fund appeared to arise only when the Companies were in a position to sell more water for the purposes of their undertaking. The sinking fund would not be a liability upon them until they utilized the reservoirs.

THE CLERKENWELL ESTATE.

Mr. BALFOUR BROWNE then proceeded to raise the question as to whether the profits of the Clerkenwell Estate were to be included in the general undertaking of the New River Company. He contended that the Company was a Land as well as a Water Company.

Mr. CRIPPS followed on the same side.

Mr. MOULTON argued that there was not the slightest justification for the contention that the Company was a Land as well as a Water Company. Looking at their Charter, and having regard to their early history, it would be found that the Clerkenwell Estate was actually bought for the purposes of the undertaking.

Sir *John Hollams*, in reply to Mr. CRIPPS, said that each owner of an Adventurer's or a King's share, or part of one, was the owner of a freehold estate. When these shares were sold, the title had to be deduced in the ordinary way. When the water stock to be allotted to the New River Company had to be distributed, there would be the responsibility of seeing that the stock was given to the parties who were entitled to it in fee without encumbrance to the property.

Mr. CRIPPS: With regard to the difficulties, could you assist the Court as to the cost which would be involved?

Witness: It is the roughest estimate possible; but, on an average, I think somewhere about £20 apiece would be incurred by the shareholders in deducing their title.

The PRESIDENT: £20 for the six people?

Witness: No; there are 212 owners of Adventurers' shares, or parts, and 532 of King's shares. One-eighth of a share may cost as much in deducing the title as an entire share.

Mr. CRIPPS: That would be about £15,000.

Witness said this would be quite irrespective of the expense the Company would have to incur in investigating the title on the other side. He put the costs to the Company at about the same. This did not include the cost of the Special Act. If not opposed, it would be about £1000. [This was amended to £1500 in the schedule which it was arranged should be put in on Saturday morning.]

Twenty-First Day—Saturday, Nov. 28.

Mr. *Searle* was recalled this morning, and stated, with regard to the Clerkenwell Estate, that the accounts went into a common account up to 1871; but after that year a special account was kept. The highest rates reached by the £100 New River stock had been 410 and 437. Before 1879, the Governors had paid £3600 a year in respect of the land-tax. But after the passing of the Redemption Act, the Company recommended the shareholders to redeem their individual shares; and the majority did so.

Mr. BALFOUR BROWNE put in a schedule, prepared by Sir John Hollams, as to the cost of distribution of Water stock and parliamentary expenses.

Mr. *Charles Hawksley* was the next witness. He said that the 31·1 gallons daily water supply per head in the New River Company's district was ample for present and future wants. In 1897, the supply was 31·6 gallons; in 1899, 31·4; in 1901, 31·7; and in 1902, 31·7. There had been a slight falling off in the amount in 1903. He was familiar with the filtration of the Company's watershed, which extended over 16½ acres.

Mr. BALFOUR BROWNE: Having regard to the filter-beds and the rate of filtration, are they sufficient to make a perfectly good water?

Witness: Yes.

Mr. *E. M. Eaton*, in examination by Mr. CRIPPS, said there would be no difficulty in bringing the consumption of 31·1 gallons per head down two or three gallons. Referring to his own experience in Sheffield, he said that in 1869 the consumption was over 41 gallons per head per day; in 1875 it was brought down to 19½, and in 1877 to 17·06. The domestic supply was brought down in 1877 to 13·44 gallons per head per day, and it was 13·14 last year.

Mr. BALFOUR BROWNE: That will be the case for the New River Company.

The PRESIDENT: I think we have determined, or are in course of determining, the legal questions in connection with this case.

Mr. BALFOUR BROWNE: I think so. Until you have determined the points still outstanding, we cannot put in an absolutely adjusted table.

The PRESIDENT said there were only two points outstanding—the Staines reservoirs, which was a question of fact, and the Clerkenwell Estate, which was mainly a question of law.

Mr. BALFOUR BROWNE said the dividends before 1852 might become material.

The PRESIDENT: The Lord Chancellor has been good enough to inform us that Lamplough's case will be considered on Dec. 14. It seems desirable that we should have any light possible from the case before we decide.

Mr. MOULTON then opened the case on behalf of the Water Board. He submitted that all the legal points had not yet been put, because he was going to ask for a decision on a matter which went to the root of all these valuations—the question whether or not the Water Companies had statutory obligations to supply water. It was a surprising contention that the New River Company should be allowed to say: "We have water up to 1907, and from and after that we will enjoy the perpetual possession of the top amount of our dividends, and the public may find further water wherever it can." This affected the whole of the valuations, and appeared to him to be a *reductio ad absurdum* of the proposition. He proposed to commence by dealing with the question of the New River Company. The Companies all differed slightly in the terms of their Special Acts; but they differed not at all in the terms of the Water-Works Clauses Act, except in so far as the incorporation clause might differ. He would argue it for the purpose of the New River case, and submit that there was a statutory obligation upon the Companies to supply water throughout all their district, subject to the provisions of the Special Act and those portions of the Water-Works Clauses Act which were incorporated. His learned friend had taken up a position with regard to the Companies which had never been taken up before. In the Llandaff Commission's report, it was mentioned that they had statutory obligations in all their districts; and this had never been controverted. So far as any public matters were concerned, this was the first time it had ever been put in issue. His learned friend appeared to take up a position as if a man in business were to call his creditors round him and say: "I am unable to fulfil my trade obligations, consequently I will retire on my capital."

Just in the same way, the Companies wished to say "We are unable to perform our statutory obligations, and therefore we will continue to enjoy in perpetuity the dividend that we are obtaining." They could not maintain that position.

The PRESIDENT: Mr. Balfour Browne seemed rather to say: "We will carry out our obligations so far as we can; but we cannot prophesy with regard to the Water Companies."

Mr. MOULTON: He said: "I cannot prophesy for the future; and therefore I claim a perpetuity."

The PRESIDENT: I do not see that his argument involves a proposition of law that they are under no liability.

Mr. MOULTON: Down to 1907, but looking beyond, the future depends on what are the statutory liabilities of the Company. I understood the view of the tribunal was that it was not their duty to speculate as to the action of Parliament. They must take the Companies as they stand—they must consider the value to the Company under existing law, they must not take evidence or even tax their imagination as to whether or not certain applications to Parliament which might be made in the future would or would not be successful. Assuming we are not to speculate on the action of Parliament, they say: "We have enough water to supply the customers we have till 1907, and not beyond."

Sir JOHN WOLFE-BARRY: They do not. They say: "After that, we shall have to go to Staines."

Mr. MOULTON said if that were so, the future beyond 1907 would not show them the annuity which they talked of, but would show a rapidly diminishing dividend. Of course, the chief sources of water were those they had been using in the past. His learned friend did not accept the pecuniary consequences of going to Staines, which would mean a large diminution of his dividend; but took up the position: "We are not claiming anything in respect of Staines." The fact was Mr. Balfour Browne was claiming perpetuity through Staines without paying the price for it. Therefore he (Mr. Moulton) wished first to have it quite clear that in 1907, in one way or another, they must find the water to perform the statutory obligation of supplying the whole of their district. It was immaterial to him whether they chose to do this from moneys in their possession, from revenue, or from any other source, or whether they took Staines, with the exception that if Staines was the source, then Staines was an advantage which had to be excluded from the valuation. He quite agreed that their future was in Staines. It must be. They were required to perform the obligation to supply their district. How were they going to do it after 1907? The Court must feel that he had a right to put this question to his learned friend.

Sir JOHN WOLFE-BARRY: I have a note here that Mr. Balfour Browne said in his speech that the Staines reservoirs were not to be drawn on till after 1907.

Mr. MOULTON: That is their case; but my learned friend, in his argument on the figures of valuation, has contrived to make the assumption that he would be able, without Staines, to continue his annuity in perpetuity. I am entitled, on behalf of the Water Board, as representing the public, to say that you must look to their actual future; and in the future they would have had statutory obligations which would be a growing burden.

After further argument,

The PRESIDENT asked if Mr. Moulton would be content with a decision in one case, or would he wish to argue it again in each case.

Mr. MOULTON said the words of the Special Acts were not the same in all cases.

The PRESIDENT said that would have to be considered; but so far as the decision went upon the Water-Works Clauses Act, he supposed the Court would not be asked to give more than one decision.

Mr. MOULTON: No; one would cover them in my opinion. But I cannot suggest that a decision in this case would bind the others, because they may rely on the terms of their Special Acts.

Mr. BALFOUR BROWNE said that if the Court gave a decision in the New River case, it would be an authority in any other case. But there were other gentlemen appearing in other cases; and they might like to submit arguments which he had overlooked altogether.

The PRESIDENT: I do not think it is at all likely that you will overlook any arguments.

Mr. MOULTON then concluded his argument on the point in question with regard to the New River Company's case.

The PRESIDENT: State exactly what you wish us to declare in this case.

Mr. MOULTON: That the New River Company are under a statutory obligation to supply all owners and occupiers of houses within their district with pure and wholesome water, and to lay down the necessary pipes for the purpose, subject to the owners and occupiers complying with the conditions of section 34 of the New River Company's Act, 1852.

After some discussion as to procedure,

Mr. BALFOUR BROWNE said he thought the better way would be for his friend to finish his case, and then let him reply on the whole matter. If a decision were given now, his learned friend would still have to put his case in the alternative, as the matter would be sure to be carried elsewhere, whatever the decision might be.

After a short deliberation in private,

The PRESIDENT, on re-entering the Court, said: At present we are not at all clear that the affirmation or negation of Mr. Moulton's proposition would influence our decision in this case. We therefore propose to go on with the evidence; Mr. Moulton being, of course, at liberty to bring forward any evidence which he thinks would affect our mind as to the probable dividend which would be received by the Company after 1907, supposing the Company had gone on. Should it afterwards appear that the proposition is one which is necessary to our decision, we shall give an opportunity of carrying it further.

Mr. MOULTON then resumed his opening speech on behalf of the Water Board. He said he would proceed on the assumption that the dividend after 1907 had to be investigated just as much as the dividend before 1907, because they had to forecast the future of the Company. As the tribunal had stated that a decision on this point would not necessarily affect their judgment, he was entitled to open the case on the supposition that there was this liability on the part of the Company. If the tribunal came to the conclusion that their decision would depend upon whether or not the liability did exist, of course, they would then decide the point. In taking the income of the Company from 1902 to 1907, an absolutely fictitious system had been followed. The liabilities had been omitted entirely. The full income of the Company had been taken; but the full expenditure had not. The whole of the valuation was on a fictitious principle—the value of what was not, and could not be, the net divisible income in future years.

Twenty-Second Day—Monday, Nov. 30.

The PRESIDENT asked Mr. Balfour Browne for further information with regard to the estates of the New River Company.

Mr. BALFOUR BROWNE said he would put in the corrected accounts as to water-rentals from 1892 to 1902. It worked out exactly at an increase of 1·97 per cent. per annum.

Mr. *Searle*, recalled, put in an item of agreed account of £6002 having respect to the sale of property on the Clerkenwell Estate to the Commissioner of Police. He also promised to put in a table showing the prices of debenture stock.

The PRESIDENT said the decision as to the dividend on the Clerkenwell Estate would be given after luncheon.

As arranged the previous week, further evidence was called on both sides with regard to the Staines reservoirs.

Sir *Benjamin Baker*, in reply to Mr. MOULTON, said he had inspected the portion of the aqueduct which had been made in connection with the reservoirs. He believed it was gravel sand, which was liable to be charged with water. Everbody knew that concrete slabs were liable to be acted on by water, and also by frost. It would require renewal of the slabbing in a certain time.

In cross-examination by Mr. BALFOUR BROWNE, witness said it was not the kind of work any engineer would have designed, assuming the conduit was empty of water.

Mr. BALFOUR BROWNE: Assuming the aqueduct is always to be full of water and never emptied, is it a perfectly stable construction?

Witness: I should think if it is always full of water up to the top, the pressure would keep it up. I do not see, however, how it is to be worked if it is full of water.

Mr. *James Mansergh*, in answer to Mr. BALFOUR BROWNE, said that on the whole the works were well designed and excellently carried out. If the aqueduct were always full, practically nothing would happen to it. He could see nothing faulty in its design; and if he had been in such a situation, and with the materials at hand, he would have designed the reservoirs practically as the Engineers had done. It was a great exaggeration to say that in the Thames Valley, and with a shallow reservoir, such protection as had been suggested was necessary. It would have been out of place and extremely foolish. There was a life in the works of 25 years.

Mr. *Charles Hawksley*, in answer to Mr. CRIPPS, said that, after hearing the evidence on Friday by the witnesses for the Water Board, he went down to Staines with considerable misgivings. Having seen the works, however, those misgivings were entirely dispelled. The work was excellently done. The Engineers had exercised a wise discretion in making use of the concrete flags.

Mr. CRIPPS: Do you think this work has been done economically, having regard to the original cost and the cost of maintenance?

Witness: I do; and even assuming that the flagging had only an average life of fifty years—which I do not think at all an extravagant assumption—the money required to produce the cost of the whole of the flagging at the end of fifty years would only be £377 per annum.

The PRESIDENT: That is the estimated annual expenditure without providing for renewals?

Witness: £377, at 3¼ per cent. compound interest, would produce a sum of £39,500, which is the entire cost. It provides for its complete renewal every fifty years. Some part of it would, of course, last longer, and some shorter. Maintenance would be renewal slowly going on.

Witness added that if the aqueduct were constructed to be kept full of water, it was quite stable.

Mr. *Eaton*, recalled, in reply to Mr. BAGGALLAY, said that, in his opinion, the concrete slabs inside the reservoir at the upper part of the bank were a suitable mode of lining the reservoir under the conditions. Only two things could displace the slabs—frost and wave action. The latter could never be set up to such an extent on a reservoir of that size as to lift a block weighing almost 1000 lbs. vertically nearly 4 inches, which it must do before it could detach it from the surrounding blocks. Frost action there must be very insignificant. He himself had had experience of the use of concrete slabs, having put them in in a certain case more than 15 years ago. They were as good now as when they were put in. Frost action had practically no effect on these slabs. He saw no reason why those in the Staines reservoirs should not endure for the next fifty years. As to the aqueduct, he quite agreed with the evidence given by Mr. Mansergh and Mr. Hawksley.

Mr. *Middleton* was then recalled on the question of flood water, at the request of the President, and explained the map to the Court.

Mr. BALFOUR BROWNE said these were all the witnesses he desired to call, and he was quite willing to leave the matter on the evidence.

The PRESIDENT said that Sir John Wolfe-Barry would visit the spot, and he might possibly go with him.

It was agreed that an Engineer on each side should accompany the members of the Court on their visit.

Mr. MOULTON then continued his opening speech. He said that, with regard to the future, a fictitious future must not be taken.

The PRESIDENT said it was a fictitious future which the Court had to deal with. That was the unfortunate part. It was a future which would never arise.

Mr. MOULTON said his point was that, in estimating the future, a fictitious future must not be taken—such a future as would never arise even assuming the Company continued to exist. To his astonishment, his learned friend had said that the cost of making the works must be excluded from consideration. There was not the slightest justification for this by any process of financial reasoning. The tribunal were

going to value the undertaking by hypothetically allowing the Company to go on. They would calculate what the income next year, the year after, and so on would be; and then they would say: "The Water Board have deprived the Company of that income, and they must pay a fair equivalent." But the fair equivalent must be what the income really would be. It was illegitimate to take for next year an income which they could not and would not get, and then say they had to give an equivalent for that. This was what the whole of his learned friend's case had been based upon.

After the short adjournment,

The PRESIDENT said, before Mr. Moulton continued, he would dispose of the question raised with regard to the profits resulting from the Clerkenwell Estate. The question they had to determine was whether these profits of the undertaking were within the meaning of section 75 of the Water-Works Clauses Act, 1847. What happened was this: That Act was passed, and, in 1852, by another Act, the Act of 1847 (with certain exceptions) was incorporated in the New River Company's Act, which authorized them to make certain works, and gave them certain powers. To answer the question whether this income was profits of the undertaking, they must consider how things stood in 1852, when the Legislature was minded to apply to the undertaking of the Company the clauses in question. It appeared that the Company, constituted by a Charter of James I., was empowered to hold lands, and that it did hold certain lands. These lands were partly the lands at Clerkenwell with which they were dealing, and there were also other lands in the valley of the Lea. Most, if not all, of these properties seemed to have been acquired in connection with the water-works of the Company. Many of them ceased to be required for the purposes of the Company; and for this reason they became surplus lands. But at that time the Company was in receipt of the annual income of the lands at Clerkenwell, which had been purchased 100 years before, having been conveyed by a deed of 1741. It had to be borne in mind that there was only one undertaking of the New River Company, not two—one body of shareholders, not two, one capital, not two, and one dividend declared from year to year. There was, in substance, one undertaking. He could not doubt that when the Legislature thought fit to apply to the New River Company the clauses which dealt with the amount of profits to be received by the undertakers, and used the words "profits of the undertaking," the undertaking to which they referred was the entire concern of the Company. Consequently, the profits of these estates were parts of the profits of the undertaking, and must therefore be brought into the dividend. In opposition to this conclusion, several arguments had been addressed to the Court. One was that the purchase took place, not by the payment of a capital sum, but by the payment from year to year of a rent charge; and therefore it was said, though he hardly knew why, that they were not part of the undertaking. The undertaking was constituted not merely of what was bought out of principal, but of what was bought out of accumulations or expenditure of income. Another argument was that the Water-Works Clauses Act provided, by section 2, that "undertaking" should mean the water-works and the works connected therewith. This was not a negative, but an affirmative clause. It said it should mean that—it did not say it should mean nothing more; and it appeared to him to be clear that the word "undertaking" as used in section 75 did not exclude other property than the water-works and the works connected therewith, and did not confine it in a narrow sense to these works. Suppose the case of the Company having a large balance at its bankers—that was not water-works, nor was it works connected with it. It seemed to him to be impossible to contend that the interest paid by the bankers upon that deposit would not be part of the profits of the undertaking and be brought in accordingly. Of course, the Legislature might have constituted two undertakings if it had thought fit; but it was not minded so to do. It was minded still to treat the undertaking which in 1852 was one, a *universitas*, as a single undertaking. The Company acted upon the view which they were now repudiating. From 1852 downwards until 1871, they treated these rents as part of their common undertaking, and brought them into a common account. They divided the dividend; and it was included in the receipts. Therefore they treated it as part of the single undertaking of which they were the owners. Then came the legislation of the year 1871; and this was addressed to the auditing of the accounts of the Water Companies of the Metropolis, and the publication of the water accounts which were submitted to the Auditor. This was the general scope and intent of the Act; and there was a provision that nothing in it should be deemed to apply to any of the landed estates, houses, or property of the Company not directly used for, or connected with, their water supply, or to empower the Auditor to audit any accounts of the Company other than those connected with the water supply. The consequence of this was that it became necessary for the Company to separate their accounts into two—those which related directly to the water supply, and those which did not—whereupon they did draw a distinction, and set aside the Clerkenwell rents into a separate account. What happened was this: They sold other properties, including a land-tax upon property at Blackfriars, and introduced into the same account three items of adjustment, which resulted from the subsequent sales. These were sales of property, not at Clerkenwell entirely, but some of them elsewhere; but it was thought desirable to introduce them. In so doing, they presented two accounts to the members of the Board—it appeared they never presented any accounts to their shareholders as such. But they did not treat them as though they were two undertakings—they did not apportion the Directors' fees, or the remuneration of the Directors, between the land income and the water income, they did not apportion the general expenses of the Company, they charged all these to the water accounts. And why? Because it was immaterial, because the land account was merely taken out for purposes of audit, and not because it constituted the profits of a separate undertaking. The Court were therefore prepared to hold that the profits of these lands were part of the property of the Company. He ought to advert to the fact that other statutes were referred to—the one which set aside the sinking fund, and the statute under which they were now sitting. These drew a distinction for entirely other purposes. The Legislature was minded not to include in the calculations with regard to the sinking fund the income of that estate. Of course, if the Legislature had gone further, and said they should be deemed to be two undertakings, that would have altered the case. But not having done so, it remained part of the profits of the undertaking, and must be dealt with accordingly.

Mr. MOULTON then resumed his opening speech on behalf of the Water Board. The learned Counsel dealt with the position of the New River Company with regard to his claim to debit in respect of their outgoings for Staines, maintaining that these were real outgoings. The whole of his case would be subject to the difficulties of prophecy—an attempt to get at future facts. He realized that prospective revenue was liable to errors; but there was no reason why it should be falsified. He was going to put, as nearly as possible, what would be the actual net divisible revenue if the Companies went on. He could not understand the fiction by which his learned friends threw liabilities away from the Company. With regard to the interest charges, they would be borne in equal thirds, and would be *de facto* paid out of the incomings of all these future years. He would deduct them right up to 1907 as being actual liabilities, and beyond, in order to estimate the non-fictitious prospective income. In doing so, he would be challenging the accounts put before the Court on behalf of the Company in many particulars. Referring to Table T, "Payments to Staines Reservoirs Joint Committee," the total payments from 1897 to 1902 were £41,981, *plus* £1749 interest; and then the Company had estimated the payments for 1903 and 1904, with interest, at £19,600. Table T as amended added £120,787 as a claim for expenses in connection with the Staines supply. By what right were these claimed? They were calculating in respect of the income; and these expenses would never be paid back in specie. The interest the Company had paid on the "D" debentures they claimed back in specie, though it was money spent on their own works—works which they admitted they would have to use after 1907, when they had to deal with the earnings of that perpetuity which they were asking the Court to value. How could this be justified? All these amounts appeared in the sum of £120,787, which was a claim for expenses in connection with the Staines supply. The whole of it related to the past, or to 1903 and 1904, and it was indefensible. The learned Counsel proceeded to criticize in detail Table T as amended. He submitted that the Court would have to decide what date in the future was a fair one for considering that the sinking fund in respect of the Staines reservoirs should commence—that was, when it was fair to say that water was obtained by means of these works. If water was kept there steadily, ready to be used, it became water so obtained. As to the capitalization in Table T as amended, he agreed with the amount of maximum dividend, but not with the multiplier. They, of course, objected to the system of capitalization.

The PRESIDENT: Do you agree on the amount of back-dividends?

Mr. MOULTON said they would be seriously altered. Claims for expenses in connection with the Staines supply went out; and the "estimated balance available for the payment of back-dividends" was an estimate of balance in hand, which would be seriously altered by the decisions that had been given. The amount of back-dividends was altogether wrong. Though in one sense it was a question of past figures, as to which there could be no two opinions, yet the estimate of the amount of back-dividends had to be altered enormously. To begin with, the Company had not regarded the land-tax as a distribution of dividend; and the consequence was that the dividends which they showed the shareholders had received were too small by the amount of the tax.

The PRESIDENT: What we have decided is that the land-tax is paid on behalf of the shareholders.

Mr. MOULTON said that was so; but the Company had not taken this decision into account. To the dividend must be added the sums paid on behalf of the shareholders at their request. There was also a point as to whether, in the first half year when the Act was passed, the dividend ought to be put in. That was a matter of argument.

Twenty-Third Day—Tuesday, Dec. 1.

The case of the New River Company was continued to-day.

Mr. MOULTON said the award would have to be given in stock; and this would be an important factor in the case, so far as the capital value was concerned.

The PRESIDENT remarked that if it became necessary to deduct the value of the Clerkenwell Estate from that of the whole undertaking, probably the best course would be for the Court to appoint a valuer, who would assist them with his opinion. It was undesirable that they should have surveyors in the box—one swearing up and the other swearing down.

Mr. MOULTON said that if they could show, as they expected to do, that the undertaking would bring in so much less than 10 per cent., and the Clerkenwell Estate would not carry it over 10 per cent., it was quite sufficient to value what they were going to take away. But supposing that the water undertaking, with the estate, would come to more than 10 per cent., then the maximum value of the whole thing to the Company would be the capitalized value of the 10 per cent. His learned friend and he would do their best to assist the Court to put the matter into practical shape.

Sir JOHN WOLFE-BARRY: Going back to the question of water stock, is it necessary for us to find the capital value of the stock, or could we find the value in income of water stock? Could we find the value at so much a year in water stock?

Mr. BALFOUR BROWNE: I am afraid not. It is not merely the income I want, but the capital sum. If the stock is 90 for every £100, I may only get £90.

The PRESIDENT: You can still express it in the income, whether it be 90 or 100. There would be so much water stock as would produce £100 a year.

Mr. MOULTON thought, in one way or another, it could easily be expressed in water stock.

At the conclusion of the learned Counsel's speech,

Mr. *H. E. Haward*, Comptroller of the London County Council, was called, and examined by Mr. FREEMAN. He said, with regard to the payment of the amount of compensation in stock, he was of opinion that the capital value of the undertaking must be first arrived at as a

sum of money, and that the amount of new water stock equivalent to such sum must be determined by the Court, if not agreed upon between the parties. The second process depended upon the rate of interest to be attached to the new stock, and upon the conditions as to redemption and other matters affecting its market value, and could not be properly determined until these were known. The Water Board would probably not be in a position to settle these points for some time. The determination now of the value to be assigned to each £100 of the new water stock for the purpose of issue to the New River Company might hamper the Board when they had to invite the public to subscribe for more of the stock for payment of the purchase-moneys to the other Companies. The Court having decided that the Company were limited to a 10 per cent. dividend on their share capital of £2,019,958, the Company could not claim to be purchased on the basis of an income of more than £201,995. If an income of 10 per cent. on a capital of £2,019,958 was all that the shareholders were legally entitled to, and they were retaining for their own benefit estates valued at a certain sum, then that value must be deducted from the amount of the compensation payable to them, if based on the 10 per cent. dividend. The effect of his tables was to show that the Company would not be able to earn 10 per cent. in the future. He thought that a valuation of the lands was necessary, because it might be that the capital value of (say) a 9 per cent. dividend, *plus* the capital value of the lands, would turn out to be larger than the capital value of a 10 per cent. dividend, which was all the Company were entitled to. The average net profits for the past ten years were £258,113; but two factors rendered this figure impossible as a guide to the future—viz., the growth of the interest charge and of the sinking fund liability, which had only recently begun to make themselves felt. With regard to the adjusted water-rental, the increase by 1·97 per cent. per annum was too high. It appeared that the 1·97 per cent. took into account the estimated increased possible revenue from specially rated City and other properties. An exaggerated percentage was therefore applied to an arbitrarily increased rental for 1902, and the rentals for future years were increased in a twofold manner. It was also to be noted that this increased rental was used as the divisor in calculating the percentage of working expenses. Any adjusted percentage of working expenses was obviously fallacious as a guide to the future. He had prepared an estimate up to 1911, as by that date the whole of the authorized unissued capital of the Company would have been issued, and become subject to sinking fund liability. The future of the Company beyond that year was a proper subject for consideration. It was difficult, in the case of the New River Company, to draw any conclusion as to future profits from a mere study of the profits in past years. The dividend paid on the share capital had increased steadily until it reached 11·93 per cent. in 1883. It then remained absolutely stationary until 1893. It then again rose gradually up to 13·65 per cent. in 1900, when it fell off, and had not shown any signs of renewed increase.

Mr. FREEMAN: The Company have, in fact, been enjoying a long period of growing prosperity, owing to their ability to get their water cheaply, and to the very remunerative character of the portion of their district inside the county of London?

Witness: Yes; but they have now to face a period of less productive capital outlay, due to the fact that additional supplies of water from Staines will be very expensive, and that the new supplies are wholly in the less remunerative districts outside London. They have, moreover, arrived at the point at which the interest of the public in the profits of the undertaking has begun to mature in the shape of payments to the sinking fund.

In further examination, witness said the Company sought to escape from their obligations for supply in the immediate future, and had not regarded the position of their undertaking beyond the year 1907. They calculated that in that year they would come to an end of their resources, and would have to use the water obtained through the Staines works. With regard to the voluminous tables prepared, he had endeavoured to forecast the future profits of the Company, starting from the present time, and using the average of past years as a guide on the question of the growth of the water-rental and the proportion of working expenses. Tables H and H 1 showed that the water-rental of the Company for the past five years had increased by an average of £9330 per annum; and witness said he had assumed that the corrected water-rental of £604,542 for 1902 would increase by £9500 per annum in the future. Table H 2 showed an analysis of the water-rental of the Company for the ten years ended 1902. The net rental rose from £509,112 in 1893 to £602,214 in 1902—an increase of 1·06 per cent. Table H 3 showed the estimated future income and trading profits on the assumption that the corrected net water-rental for 1902—viz., £602,214—increased by £9500 per annum. The net amount, after deducting the sinking fund (calculated on possible dividends), was estimated to be as follows: (1903) £222,559, the equivalent rate per cent. on a capital of £2,019,958 being 11·01; (1904) £199,370, 9·87 per cent.; (1905) £197,616, 9·78 per cent.; (1906) £163,692, 8·10 per cent.; (1907) £164,144, 8·13 per cent.; (1908) £165,525, 8·19 per cent.; (1909) £166,728, 8·25 per cent.; (1910) £167,778, 8·30 per cent.; (1911) £169,052, 8·37 per cent. Table H 4 gave the estimated interest charge from 1903 to 1911, excluding interest on the intercommunication stock. The totals were: (1903) £89,205; (1904) £97,411; (1905) £102,761; (1906) £103,411; (1907) £103,890; (1908) £104,540; (1909) £105,190; (1910) £105,840; (1911) £106,490. Table H 5 showed the estimated sinking fund deduction on the basis of a dividend of 10 per cent. per annum, rising from £8428 in 1903 on a liable capital of £249,339, to £54,145 in 1911, on a liable capital of £1,806,666. Table H 6 showed that the total amount expended under the Act of 1896 ("C" debenture stock) up to Dec. 31, 1902, was £295,257. Deducting the proceeds of the amount of stock issued up to Dec. 31, 1902—£249,339—the balance overdrawn on that date was £45,918. Table H 7 showed the percentage of working expenses to water-rental for the five years ending 1902 to be: (1898) 42·79; (1899) 42·27; (1900) 43·29; (1901) 46·35; and (1902) 44·98. The average per cent. was 43·93; deducting rates and taxes, 13·86, and adding rates and taxes, 16·22, less 0·58, the adjustment for land-tax, in accordance with

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 606.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	Oct. 15	10½	Alliance & Dublin 10 p.c.	18½–19½	..	5 7 8
100,000	10	,,	7½	Do. 7 p.c.	12½–13½	..	5 11 1
200,000	5	Nov. 12	6⅝	Bombay, Ltd. . . .	5½–6	..	5 8 4
140,000	5	,,	6½	Do. New, £4 paid	4–4½	..	5 15 7
380,000	Stk.	Aug. 13	12	Brentford Consolidated	228–233	–2	5 3 0
300,030	,,	,,	9	Do. New . . .	173–178	..	5 1 1
50,000	,,	,,	5	Do. 5 p.c. Pref. .	150–135	..	3 14 1
206,250	,,	June 11	4	Do. 4 p.c. Deb. .	105–110	..	3 12 9
220,000	Stk.	Sept. 11	10⅝	Brighton & Hove Orig.	207–212	..	5 1 5
246,320	,,	,,	7½	Do. A. Ord. Stk. .	145–150	..	5 3 4
460,000	20	Oct. 15	10	British.	38½–39½	..	5 1 3
100,000	Stk.	Aug. 13	6	Bromley, Ord. 5 p.c. .	115–120	..	5 0 0
165,700	,,	,,	4½	Do. do. 3½ p.c. .	88–93	..	4 16 9
500,000	10	Oct. 15	7	Buenos Ayres (New) Ltd.	10⅞–10⅝	..	6 10 3
250,000	Stk.	June 26	4	Do. 4 p.c. Deb.	93–95	..	4 4 3
150,000	20	July 10	8½	Cagliari, Ltd. . . .	21–24	..	6 17 6
100,000	10	June 11	10	Cape Town & Dis., Ltd.	14–15	–½	6 13 4
50,000	50	Nov. 3	6	Do. 6 p.c. 1st Mort.	52–54	..	5 11 1
1,375,000	Stk.	Aug. 27	5⅛	Commercial 4 p.c. Stk.	104–107	..	4 17 3
593,750	,,	,,	5	Do. 3½ p.c. do.	97–100	..	5 0 0
442,947	,,	June 11	3	Do. 3 p.c. Deb. do.	87–90	..	3 6 8
800,000	Stk.	June 11	7	Continental Union, Ltd.	118–123	..	5 13 10
200,000	,,	,,	7	Do. 7 p.c. Pref.	130–135	..	5 3 8
575,000	Stk.	Aug. 27	5⅜	Crystal Palace Ord. 5 p.c.	112–117	..	4 11 1
60,000	,,	,,	5	Do. 5 p.c. Pref. .	118–123	..	4 1 4
112,533	,,	July 10	5	Do. 5 p.c. Deb. Stk.	135–138	..	3 12 6
486,090	10	July 29	10½	European, Ltd. . . .	18–19	..	5 10 6
354,060	10	,,	10½	Do. £7 10s. paid	13–14	..	5 12 6
15,243,200	Stk.	Aug. 13	4⅛	Gas- 4 p.c. Ord. . .	86–88	–2	5 0 0
2,600,000	,,	,,	3⅜	light 3½ p.c. max. .	86–88	..	3 19 7
3,799,735	,,	,,	4	and 4 p.c. Con. Pref.	107–110	..	3 12 9
4,193,975	,,	June 11	3	Coke 3 p.c. Con. Deb.	87–89	..	3 7 5
258,740	Stk.	Sept. 11	5	Hastings & St. L. 3½ p.c.	90–95	..	5 5 3
70,000	10	Oct. 15	11	Hongkong & China, Ltd.	16–17	..	6 9 5
3,800,000	Stk.	Nov. 12	10	Imperial Continental .	200–203	..	4 18 6
473,600	Stk.	Aug. 13	3½	Do. 3½ p.c. Deb. Red.	98–100	..	3 10 0
165,242	Stk.	Aug. 27	6	Lea Bridge Ord. 5 p.c.	113–118	..	5 1 8
561,000	Stk.	,,	10	Liverpool United A .	213–215	..	4 13 0
718,100	,,	,,	7	Do. do. B .	163–165	..	4 4 10
306,083	,,	June 26	4	Do. do. Deb. Stk.	110–112	..	3 11 5
75,000	5	June 11	5	Malta & Medn., Ltd. .	4¼–4⅝	..	5 5 3
560,000	100	Oct. 1	5	Met. of 5 p.c. Deb.	101–105	..	4 15 3
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	100–102	..	4 8 3
541,920	20	Nov. 12	3½	Monte Video, Ltd. . .	9–10	..	7 0 0
1,515,892	Stk.	Aug. 13	4½	Newc'tle & G'tesh'd Con.	106–107	..	4 4 1
376,855	Stk.	July 3	3½	Do. 3½ p.c. Deb.	96–97	..	3 12 2
300,000	Stk.	Nov. 26	8	Oriental, Ltd. . . .	135–140*	..	5 14 4
600,000	5	Sept. 30	7	Ottoman, Ltd. . . .	5⅞–6⅛	..	5 7 8
					* Ex div.		

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
205,005	Stk.	June 26	6⅝	Ply'mth & St'house 5 p.c	123–128	..	4 15 8
851,070	10	Oct. 15	7	River Plate Ord. . .	10⅞–11⅛	+⅛	6 4 5
300,000	Stk.	June 26	4	Do. 4 p.c. Deb..	94–96	..	4 3 4
250,000	10	Sept. 30	8	San Paulo, Ltd.. . .	10⅞–11⅛	..	6 19 2
135,000	Stk.	Sept. 11	10	Sheffield A	240–242	+1	4 2 8
209,984	,,	,,	10	Do. B	240–242	+1	4 2 8
523,498	,,	,,	10	Do. C	240–242	+1	4 2 8
116,106	Stk.	Sept. 30	5	Shrewsbury Ord. 5 p.c.	109–112	..	4 9 3
6,150,000	Stk.	Aug. 13	5⅛	South Met., 4 p.c. Ord.	119–122	..	4 7 4
1,780,000	,,	July 10	3	Do. 3 p.c. Deb. . .	87–90	..	3 6 8
380,940	Stk.	Nov. 12	5	Southampton Ord. . .	105–110	+1½	4 10 11
87,950	,,	July 10	4	Do. 4 p.c. Deb.	102–105	..	3 16 2
120,000	Stk.	Aug. 27	6	Tottenham A. 5 p.c.	115–120	..	5 0 0
313,020	,,	,,	4½	and Edmonton B. 3½ p.c.	95–100	..	4 10 0
182,380	10	June 11	8	Tuscan, Ltd.. . . .	8–9	..	8 17 10
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	58–100	..	5 0 0
737,142	Stk.	Aug. 13	5	West Ham, 5 p.c. Ord.	95–100	+2	5 0 0
				WATER COMPANIES.			
780,776	Stk.	June 26	11⅛	Chelsea, Ord. . . .	300–310	..	3 14 2
150,000	,,	,,	5	Do. 5 p.c. Pref. .	140–145	..	3 9 0
160,000	,,	,,	4½	Do. 4½ p.c. Pref. '75	131–136	..	3 6 2
175,785	,,	Sept. 30	4½	Do. 4½ p.c. Deb. .	132–137	..	3 5 8
1,720,560	Stk.	Oct. 15	8	East London, Ord.. .	205–215	..	3 14 5
654,740	,,	June 11	4½	Do. 4½ p.c. Deb. .	138–143	..	3 2 11
1,282,943	,,	,,	3	Do. 3 p.c. Deb. .	90–94	..	3 3 10
700,000	50	June 11	10	Grand 10 p.c. max..	118–123	–2	4 1 4
310,000	Stk.	Sept. 30	4	Junction 4 p.c. Deb..	120–125	..	3 4 0
208,000	Stk.	Aug. 13	10	Kent	265–275	–5	3 12 9
160,000	,,	,,	7	Do. New, 7 p.c. max..	185–195	..	3 11 10
1,043,800	100	June 26	11	Lambeth, 10 p.c. max..	285–295	..	3 14 7
406,200	100	,,	8⅓	Do. 7⅓ p.c. max..	205–215	..	3 19 1
350,000	Stk.	Sept. 30	4	Do. 4 p.c. Deb..	120–125	..	3 4 0
500,000	100	Aug. 13	12⅛	New River, New Shares	315–325	–20	3 18 9
1,000,000	Stk.	July 29	4	Do. 4 p.c. Deb..	117–120	–3	3 6 8
902,300	Stk.	June 11	7½	South- Ord. . . .	225–235	..	3 3 10
126,500	100	,,	7½	wark 7½ p.c. max.	200–210	..	3 11 5
489,200	Stk.	,,	5	and 5 p.c. Pref. .	140–145	..	3 9 0
1,019,585	,,	Oct. 15	4	Vauxhall 4 p.c. A Deb.	118–123	..	3 5 1
1,155,066	Stk.	June 11	10	West Middlesex. . .	275–285	–2½	3 10 2
200,000	,,	,,	4½	Do. 4½ p.c. Deb. .	132–137	..	3 5 8
200,000	,,	Sept. 11	3	Do. 3 p.c. Deb. .	89–92	..	3 5 3
					* Ex div.		

the decision of the Court, the percentage assumed for the year 1903 (increasing 0·25 for each subsequent year) was 45·71—say, 45½. Table H 8 showed the payments by the three Companies to the Staines Reservoirs Joint Committee in the six years 1897-1902 to be: New River Company, £41,981; Grand Junction Company, £41,981; West Middlesex Company, £41,981—total £125,943. Table H 9 gave the estimated annual cost to be borne in future as £64,500, or £21,500 by each Company. Table H 10 showed the amount of the sinking fund deduction in respect of capital authorized by the Company's Acts of 1896 and 1897, and by the Staines Reservoirs Acts. The total of £41,887 in 1911, as in Table H 3, was made up of £9204 under the Act of 1896, £23,600 under the Act of 1897, and £9083 under the Staines Acts. Table H 11 gave the estimated annual cost of pumping, maintenance of works, and interest on excess expenditure in respect of the works authorized by the Act of 1897, rising from £16,700 in 1906 to £22,500 in 1911. Table H 12 showed the past and future expenditure under the Act of 1897 and the Staines Reservoirs Acts which the Company eliminated from consideration in their estimates of the profits on which their claim for compensation was based. The total expenditure from 1897 to 1902 was £63,706; and the estimated expenditure for 1903 and 1904 was £51,535. The estimated ultimate annual liability in respect of the works authorized by the Act of 1897 and the Staines Reservoirs Acts was £110,119.

Mr. *William Plender*, the Accountant to the Water Board, put in certain tables. Table 1 showed the capital authorized to Dec. 31, 1902, to be £5,450,036 15s. 7d.; capital issued, £4,667,296 os. 5d.; amount remaining unissued, £782,740 15s. 2d. Table 2 showed the dividends of the Company from 1852 (six months) to 1902. From 1883 onwards it had been upwards of 12 per cent. on the share capital, and more than 13 per cent. from 1897 to 1900 inclusive. Table 3 showed the legal and parliamentary expenses from 1893 to 1902 to be £33,477. Table 4 showed the average profit realized on testing and stamping fittings during the ten years 1893 to 1902 to be £1482. Table 5 showed the rateable value of the Company's property—rising from 5s. 4·83d. in 1893 to 6s. 8·71d. in 1902. Table 6 showed the net income required to pay dividends on the share capital issued, together with the payments to the sinking fund applicable to such rates, when all the capital subject to that fund had become liable to contribution. At 8 per cent., the income required, disallowing the 1 per cent. for management, was £188,257; at 9 per cent., £213,150; and at 10 per cent., £238,037. On the authorized capital, £1,025,900 issued, £78,766 unissued, the corresponding figures were: 8 per cent., £202,559; 9 per cent., £229,878; 10 per cent., £257,208. Table 7 showed the back-dividends. The dividends paid less than 10 per cent. on the share capital from 1852 to 1902 amounted to £1,515,049; and those paid in excess of 10 per cent. amounted to £1,267,333—the balance being £247,716 dividends less than 10 per cent. Table 8 showed that the total amount of debenture stock rose from £1,500,000 in 1893, on which £60,000 interest was paid, to £2,208,000 in 1902, on which £78,870 was paid. Table 9 showed the balance by the Company's corrected revenue account, exclusive of income from the Clerkenwell Estate, to be £246,676 11s. 10d., *plus* land-tax unredeemed, paid in 1902 by the Company, £407 9s. 8d.; making a total of £247,084 1s. 6d. The Water Board claimed to deduct from this total £10,538 1s. 4d. for law charges and the sinking fund, £950 for reductions in the contributions to the sinking fund consequent upon the above deductions from profits, and £2381 for rents relating to properties retained by the Company, forming the subject of a supplemental claim; leaving an amount of £235,115 os. 2d. Table 10 showed the sinking fund liability in respect of 1902 to be £9082 2s. 2d. Table 11 showed that the East London Company had had water from the New River Company (less the amount obtained through the Chelsea Company) of the value of £327 13s. 1d. Adding £158 18s. 5d. for passing Grand Junction and West Middlesex water through the New River Company's mains, the total sum came to £486 12s. 6d.

Sir *Alexander Binnie* was the next witness. In answer to Mr. J. D. FITZGERALD, he said he had prepared a table showing the annual average increase in consumption at 1·8 per cent., with the addition of 25 per cent. each year to provide against the month of maximum demand. The totals required to meet the demands of the maximum month were: (1902) 49,625,000 gallons; (1903) 50,518,130 gallons; (1904) 51,428,750 gallons; (1905) 52,353,750 gallons; (1906) 53,296,250 gallons; and (1907) 54,256,250 gallons. In explanation of this table, witness said the Company had a storage capacity of 100,100,000 gallons, which was equal to 2½ days' average demand. It was thus necessary to draw on their sources of supply daily; and these should be capable of yielding 25 per cent. more water than was, on an average, consumed each day. He did not think the Company could rely on obtaining more water from the existing sources than they got now; and they would be at the end of their resources in 1904, when they would have to draw water from Staines. The latter supply would carry the Company on till 1918; but it must be remembered that the Staines water would be very costly. The Company's proportion of the outlay on the Staines works was £1,686,666. The water must be pumped three times, and might have to be pumped five times, before it reached the consumer. The Company ought to provide for 54½ million gallons as a maximum for their supply. They had the smallest filtration area of any Metropolitan Water Company; and he estimated that, for efficient filtration, they should have reservoirs covering 40 acres instead of 16¾ acres. There was considerable difficulty in obtaining land for new reservoirs; and the only way, in his opinion, to get over it would be to divide the water obtained from the wells, which did not require filtration, from that drawn from the River Lea.

In cross-examination by Mr. CRIPPS, witness said that if the *bacillus coli* were found, he would condemn the water if it came from a place inhabited by human beings. It was known to be an organism of intestinal origin. This was beyond dispute.

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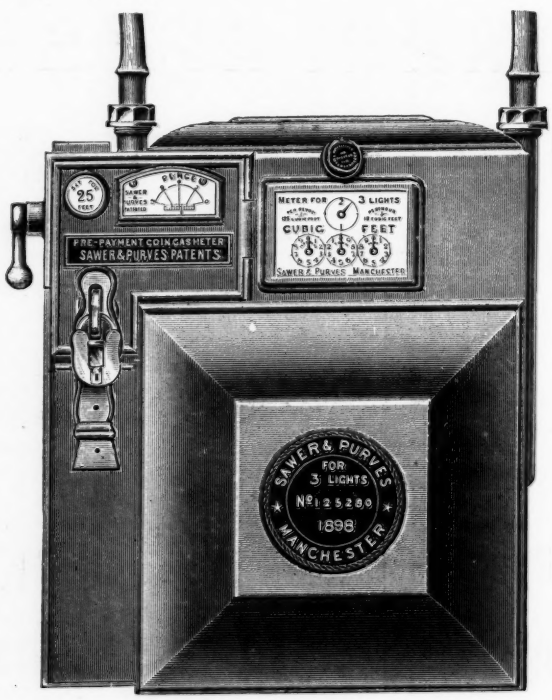

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NOTTINGHAM.

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Twenty-fourth Day—Thursday, Dec. 3.

Mr. MOULTON said he had consulted with Mr. Balfour Browne in regard to the valuation of the Clerkenwell Estate and the other lands; and it had been agreed to name a valuer sitting as an arbitrator, in whom both of them would have perfect confidence, to undertake the work. They would submit his award to the Court, so that they need not be troubled with details of evidence.

The PRESIDENT said such a course would have the approval of himself and colleagues.

Mr. BALFOUR BROWNE, at the conclusion of the evidence, said he had assumed that the Court's award would have been a final one in an alternative form; but this would be impossible, as several points had been raised for the decision of the Court of Appeal.

FURTHER EVIDENCE FOR THE WATER BOARD.

Dr. *Klein*, examined by Mr. MOULTON, said he had inspected portions of the New River, and was distinctly of the opinion that it was not satisfactorily protected against pollution with filth. His examinations showed that intestinal microbes exist in most of the filtered water of the London Companies, including those of the New River Company. He entirely agreed with Professor Koch that, even by the aid of processes of sand filtration carried out by exceptional skill and precautions, the filtrate must still remain unsafe. The raw water taken from the reservoirs of the New River Company which he had examined was of such a nature that it could not be made a safe potable water by the means of filtration which were at present practised. He therefore held that, so long as the Lea was used as a source of supply, the filtering area of the Company should be much greater than it was. He should say that the water of the New River Company, on the whole, was better than that of the East London Company; but it was not sufficiently safe or satisfactory.

In cross-examination by Mr. BALFOUR BROWNE, witness said that of twenty-five samples from the New River he found organisms of an intestinal type in fifteen, and none in ten.

The PRESIDENT: But they are not necessarily injurious to health?

Witness: No; but it would be a very wide and difficult question to decide as to the microbes which are and which are not.

Evidence was also given as to the supply and the filtration area and works by Mr. *Parry*, the Water Engineer to the Liverpool Corporation, Mr. *Deacon*, Mr. *Brough Taylor*, and Mr. *Watson*.

Mr. MOULTON said that was the whole of the evidence he proposed to call excepting certain financial evidence with regard to the value of the water stock. It was practically impossible to call this until the questions of the Clerkenwell Estate valuation had been settled, because it must bear very largely upon the future of the Company, and it might entirely alter the financial problem of estimating what the maintainable income of the Company was. He therefore proposed that it should stand over until after the valuations had been made, and the results were before the Court.

The PRESIDENT: Are you speaking of evidence as to how many years' purchase ought to be given?

Mr. MOULTON said it was not quite "years' purchase." It was the comparison as to maintainable income; and it had to be valued in water stock.

Mr. BALFOUR BROWNE said he had no objection, and

The PRESIDENT said the Court agreed.

Mr. MOULTON said another point was with regard to the question of title. Of course, in an ordinary compensation case, title had nothing to do with the tribunal. The matter had been talked over with his learned friends; and it was proposed for the acceptance of the Court that the New River Company should prove their title—he meant the sending of the abstract of title to the Solicitors to the Water Board—forthwith to all their estate except the Clerkenwell Estate and excepted lands, because these were not going to be transferred. It had been agreed that if the title of the Company to any of their estates or property should hereafter arise, such questions should be referred to the Arbitration Court, and either party might apply to the Court to make a supplemental award.

Mr. BALFOUR BROWNE said they had proceeded on the idea that they were a Statutory Company; and no doubt the investigation of their title to the lands would be a matter of the greatest difficulty. All that they were passing over was the undertaking. If it could have been pointed out that some of the lands did not belong to them, it would have been done; but he was not prepared to go into the title of the New River 200 years ago. Under the Act, they had a right to see every book and document belonging to the Company. From the beginning, all they had been trying to do was to value the undertaking as it stood.

The Court retired to consider the point, and on their return,

The PRESIDENT said they held that in this case as submitted the New River Company were in the actual possession of the lands which they claimed. No evidence had been given to show that they were out of possession of any of the lands which were part of the undertaking. It appeared to them further that the presumption in law was that the person in possession had an absolute right to the property. This presumption might be rebutted; and they proposed to give the Water Board an opportunity of rebutting it. Therefore they proposed to give liberty to the Water Board to show, at a date to be hereafter fixed, that the New River Company had no title, or a limited title, to any of the lands or hereditaments or parts of the undertaking of the Company to be transferred to the Board. If the Board should undertake a full and thorough investigation into all the property of the Company, he thought they would incur an expense which it would be extremely difficult to justify.

Mr. MOULTON said that would exactly meet their view.

The question of costs was ordered to stand over.

Mr. *Searle* was then examined by Mr. BALFOUR BROWNE respecting New River assessments and water-charges in the City.

Mr. *H. M. Robinson*, Town Clerk of the Borough of Shoreditch, was

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also examined by Mr. MOULTON as to the sinking of wells there instead of paying a Water Company—a proceeding which the borough found to be cheaper.

IMPORTANT LEGAL POINTS.

Mr. BALFOUR BROWNE then put before the Court the following points, which, he said, presented themselves to the minds of the advisers of the New River Company at the present time; but they were not necessarily exhaustive: (1) That the limitation of dividend under section 75 of the Water-Works Clauses Act, 1847, does not apply to the New River Company. (2) If it does so apply, the deficiency to be made up can be calculated back beyond the year 1852. (3) That, in calculating the maximum dividend (if any), the income from the Clerkenwell Estate, and any other landed estate, houses, or property of the Company, not directly used for, or connected with, their water supply, shall not be included. (4) That, in calculating the maximum dividend (if any), sums paid in each year to the shareholders in respect of redeemed land-tax shall not be included. (5) That, in calculating the maximum dividend (if any), the sums paid in each year to those holders of Adventurers' shares who are Directors shall not be included. (6) That the sterilization clauses contained in the Staines Reservoirs Acts are not to be construed so as to affect prejudicially the income of the Company as the same exists when such clauses come into operation. (7) That the sinking fund sections do not, upon the true construction of the same and of the Metropolis Water Act, 1902, justify the deductions proposed to be made from the income of the Company by the Water Board, and should not be taken into consideration in valuing the undertaking of the Company. (8) That upon the true construction of the sections relating to compensation in the Metropolis Water Act of 1902 contained, no deduction ought to be made from the income of the Company for charges in respect of capital created and issued but not utilized for earning that income. (9) That upon the true construction of the statutes, the Company are entitled to be recouped by the payment of a sum in cash for the sums paid by them out of revenue in respect of expenses, including the payment of interest on capital, in connection with the Staines supply, under the Staines Reservoirs Act and the Company's Act of 1897.

The PRESIDENT said the Court would consider the points that had been submitted.

Mr. MOULTON remarked that he only wished to guard himself as to the statutory obligation of the Company to supply—whether that was necessary or not.

The PRESIDENT said the Court were now prepared to say that—whether the New River Company were or were not under statutory obligations—they held as a matter of high probability, upon which they were prepared to act for the purposes of their report, that the New River Company would in the future have recourse to the Staines reservoirs and works; and taking this view, it appeared to them needless to go into the legal question.

The Grand Junction Company's case was then proceeded with.

On Saturday morning, the Court gave a pronouncement on some important legal points reserved.

The PRESIDENT said the Arbitrators had considered the various legal points which had been raised by Mr. Balfour Browne with regard to the New River and the East London Companies. [The latter Company are affected only by the point as to the sinking fund.] They were prepared to state a case for the Court of Appeal except upon three items. With regard to the point suggested as to the Directors' fees, the Arbitrators considered this a mere question of fact. As to the two last points in which they were asked to state a case—as to whether or not deductions should be made from the income of the Company in respect to capital raised and not utilized, and that the Company were entitled to be recouped with respect to all expenses connected with the Staines supply—the Arbitrators considered that both points were left to them as valuers, and not as questions of law. Therefore, they did not propose to state a case for the decision of the Higher Court on these three points. On the paper which had been put in, the learned Counsel did not state the points in the same form in which the Arbitrators had decided them. They proposed to keep to what they had decided, and to raise questions upon these points. The Arbitrators had held that, according to the true construction of the New River Company's Act of 1852, and of the Water-Works Clauses Act, 1847, the limitation of profits to be divided among the undertakers mentioned in section 75 of the last-mentioned Act applied to the profits of the Company; and in so doing, the Arbitrators had considered not only the above-mentioned Acts, but the New River Company's Act of 1866, the Metropolitan Water Act, 1871, and the New River Company's Act, 1896. The question for the Court to decide was whether or no they were right in so holding. They had held that, according to the true construction of the New River Company's Act of 1852, and of the Water-Works Clauses Act, 1847, the rents and profits of the Clerkenwell Estate, and the other lands and real estate of the Company not directly used for, or connected with, their water supply, were really part of the profits of the undertaking in section 75 of the Water-Works Clauses Act mentioned. The question for the Court was whether or no they were right in so holding. The Arbitrators had held—following the decision of the Court of Appeal in the case of the *Kent Water-Works Campany v. Lamplough*—that, according to the true construction of the New River Company's Act, 1852, and the Water-Works Clauses Act, 1847, the previous dividends, of which the deficiency might be made up as by section 75 of the last-mentioned Act provided, were only those subsequent to the passing of the said Act of 1852, and did not include those between the incorporation of the Company and the passing of the said Act. The question for the Court was whether or no they were right in so holding. The Arbitrators had held that, according to the true construction of the statutes 38 George III., caps. 5 and 60, the sums paid by the New River Company for land-tax were payments made, not on account of the Company, but on account of the several owners of shares in the undertakings, and that the said payments were not expenses of the Company. The question for the Court was whether

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WINDSOR ST., BIRMINGHAM (Second Contract)	2,000,000	COLCHESTER (Second Contract)	300,000	ROCHESTER (Second Contract)	500,000
HALIFAX	1,000,000	YORK	750,000	NEWPORT (MON.)	250,000
TORONTO	250,000	ROCHESTER	500,000	TOKIO, JAPAN	1,000,000
OTTAWA	250,000	KINGSTON, ONT.	300,000	PERNAMBUCO (Brazil)	125,000
LINDSAY (Remodelled)	125,000	CRYSTAL PALACE DISTRICT	2,000,000	MALTON	150,000
MONTREAL	500,000	DULUTH, MINN.	300,000	DULUTH, MINN. (Second Contract)	300,000
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BELLEVILLE	250,000	LEICESTER	2,000,000	SMETHWICK	500,000
OTTAWA (Second Contract)	250,000	ENSCHEDE (HOLLAND)	150,000	GRAVESEND	300,000
BRANTFORD (Remodelled)	200,000	BUENOS AYRES (RIVER PLATE CO.)	700,000	NEWPORT MON. (Second Contract)	250,000
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or no they had been right in so holding. The Arbitrators had held that, according to the true construction of the East London Water-Works Acts of 1886 and 1894, and the Metropolis Water Act of 1902, the undertaking of the East London Company ought to be valued as subject to, and not as free from, the obligations to contribute to the Chamberlain's fund created by the two first-mentioned Acts. The question for the decision of the Court was whether or no they were right in so holding. The Arbitrators had held that, according to the true construction of section 3 of the Metropolis Water Act, 1899, section applied if the powers given by that Act to a Metropolitan Water Company had been exercised with an advantage resulting to the Company as a whole, and that some abatement ought to be made in respect of this advantage, although it might not be in its nature separable from the general undertaking, and although it might not be capable of being stated as a separate item of account of claim.

The Court then resumed the case for the Grand Junction Company, the report of the proceedings in which will be given in the next issue of the "JOURNAL."

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

At the meeting of the Edinburgh and Leith Gas Commissioners on Monday, Sir Robert Cranston, who has been elected Lord Provost of Edinburgh, took his seat as Chairman of the Commission. Mr. D. Purves was re-elected Convener of the Works Committee, with Mr. Menzies as Sub-Convener. This latter arrangement is unfortunately required by the state of health of Mr. Purves, who has been Convener for only a few years. The latest account I have received of him is that his condition is very grave. Provost Mackie, of Leith, was re-elected Convener of the Finance and Law Committee. Bailie Douglas asked to be permitted to withdraw the motion he had given notice of with reference to the salary of the Engineer. The matter went to a vote; and the permission was granted by 13 votes to 6—the Lord Provost remarking that it was very much to be regretted that such a motion should have been made. Mr. Herring reported that about sixty men are being employed in connection with the extensions at Granton.

At a meeting of the Edinburgh Town Council on Tuesday, it was officially reported that the illuminating power of the gas supplied to the city on Nov. 17 was 25·30 candles. Mr. Macpherson said he thought the public should have an explanation as to the bad quality of the gas all over the city. They were met with this complaint wherever they went. He thought it would be well that he gave notice against the next meeting that he would ask for a report. Lord Provost Sir Robert Cranston said he would put a question on the matter at the next meeting of the Gas Commissioners, and this would probably elicit the information desired. On this subject, it cannot be overlooked that there is very widespread grumbling—in fact, there has been since the gas supply began to be derived from Granton. The general outcry is that inferior coal is being used; but the probability is rather that it will be found that the gas loses in its transmission to the city. It is sent through under pressure, which must be trying to it.

A very unfortunate incident of poisoning by gas happened at Penicuik on Tuesday. Beech Place, where it occurred, is almost entirely surrounded by the waters of the Rivers Esk and Black Burn. The dwelling-house next the river was occupied by Hugh Graham, his wife, and an adopted child. Next door an old man named Robert Menzies resided. On Tuesday forenoon, Menzies went for his usual walk, and on returning sat down in an arm-chair. About 12.40, his grandson found him in a state of unconsciousness. Help was procured, and the old man, on being subjected to artificial means of respiration, regained consciousness. Meantime, it was remarked by neighbours that the Grahams had not been seen that day; and their house was forcibly entered. There Graham was found in bed, dead, and his wife beside him in a state of unconsciousness. The child was also in bed, and appeared to be little the worse. Mrs. Graham regained consciousness in the course of the afternoon, and was able to say that, on the previous evening, they retired to rest about ten o'clock, and that some time afterwards her husband wakened her and asked if she had heard an explosion. She had not; but she soon became conscious of a strong smell of gas. Her husband got up and turned the gas off at the meter. He lit a candle and partially dressed himself. Then he fell upon the bed. His wife afterwards got up with the intention of lighting the fire, but fell upon the floor. She managed to get into the arm-chair, and subsequently into bed, but remembered no more. Search was instituted for the escape of gas; and on Wednesday it was found that a 1½-inch pipe which had been carried across the river more than fifty years ago had snapped. The pipe had been afterwards built over by the house in which Graham resided, and the fracture was found a few inches inside the wall of the house, and within about 6 feet of the bed where the Grahams were lying. The pipe was 37 inches from the surface of the ground at the place.

Early this week, the Electric Lighting Committee of the Edinburgh Town Council, with other members of the Corporation, paid a visit of inspection to the two electric power stations in the city. Mr. A. Donald Mackenzie, the Convener of the Committee, showed them over the stations, and at the close he "called attention to an article which had appeared in a London journal depreciating corporation electrical undertakings, and indicating that Edinburgh was far behind in its methods by not providing against the antiquation of the plant, and for not following Glasgow and Aberdeen in regard to depreciation." Of course, Mr. Mackenzie referred to the "JOURNAL." He went on to say that the article was not only unfair, but untrue; and he asked the Deputy Town Clerk to read the letter which he had written to the "JOURNAL" (see p. 425) contradicting the erroneous statements which had been made. Mr. Carmichael moved a vote of thanks to Mr. Mackenzie for his able defence of the electric system of Edinburgh.

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Mr. Mackenzie, in acknowledging the vote, said he could assure them that Edinburgh had one of the three or four most successful undertakings of the kind in the kingdom. The question of street lighting would come up in the Town Council; and although some members seemed to feel that the work should be handed over to the Gas Commissioners, he thought such a step would be a dreadful confession of failure on the part of the Council, who, for their credit, should keep the lighting of the streets in their own hands.

An incident which was somewhat awkward, but happily no more than awkward, occurred in connection with the gas supply of Dunfermline on Tuesday. It was found early in the morning that the purifiers had gone out of action. Search was at once instituted to discover the cause; but as the forenoon wore on and no discovery was made, it was realized that the consequences might be serious. A meeting of the Gas Committee was called, and a circular was issued, which stated the regret of the Committee that, owing to an unfortunate accident to a purifier at the gas-works, the supply of gas would be somewhat limited, and that, in the circumstances, the Committee would consider it a favour if all large employers of indoor labour would refrain from lighting up their works that afternoon. The request was complied with, and factories stopped work when daylight failed. There was sufficient gas to provide for domestic lighting, and the limited street lighting on moonlit nights. A large expenditure of labour was involved before the cause of the stoppage was discovered. This was found to be a lodgment of water in a most unsuspected and unaccountable position. The manufacture of gas was stopped for about eight hours.

The Gas Committee of the Dundee Corporation have had under their consideration a letter from Messrs. Stevenson Brothers regarding the special rate charged to users of gas for day consumption. The firm use a considerable quantity of gas for heating purposes, exactly as it is used in gas-engines. They have learned from competitors in Perth that the Corporation there give those in the same business the benefit of the special rate, along with day consumers by gas-engines. They cannot see any difference between the two. As they are installing an electric plant, and considering the propriety of abandoning gas in favour of electric irons, they wished to know if all day consumers of gas as fuel would be put on the same footing in regard to rate. The Committee decided that, as the rates had been fixed for the year, they could not make any alteration.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 5.

Sulphate of Ammonia.

The wide difference between prompt and forward prices is directing more attention to the prompt position, and during the week there has been improved demand, more particularly in Scotland. Supplies, however, have been sufficient to meet all requirements, and values have remained without much alteration. The closing quotations are £12 to £12 1s. 3d. per ton f.o.b. Hull, £12 1s. 3d. to £12 2s. 6d. per ton f.o.b. Liverpool, and £12 2s. 6d. per ton f.o.b. Leith. There is still good inquiry for delivery over the spring months; but in this position, makers require a premium of 7s. 6d. to 10s. per ton on prompt prices, and no important business has transpired, buyers' ideas of value being too low. It may be noted that, although speculators are underquoting makers in foreign markets, they are not taking much liberty with makers' prices.

Nitrate of Soda.

This is steady on spot at 9s. 6d. per cwt. for ordinary quality, but 9s. 9d. would now be accepted for refined. A good business has been done on the Continent in the forward position, and sellers now require an advance of 1d. to 2d. per cwt.

LONDON, *Dec.* 5.

Tar Products.

The markets for tar products are decidedly quiet, and there is very little business doing, doubtless owing to the approach of the holidays. It is extremely difficult to estimate the exact position of pitch. The prices given below may be taken, as the values quoted by manufacturers are not any indication of business done for prompt delivery. Ninety per cent. benzol continues firm. Business is reported at 11½d. for December shipment; while there is a good inquiry for next year. 50-90 per cent. is neglected, and little if any business is doing in same. Makers ask 8d.; but buyers will not pay this price. In toluol, there is a little inquiry for forward delivery; but makers are not disposed to offer except at an advance on existing prices. Solvent continues firm, and there is a good business doing; but purely for home consumption, and principally in the special qualities. Creosote is still very firm; and sellers do not seem inclined to reduce their quotations, doubtless owing to the very strong demand which prevails for prompt delivery. In anthracene, there is an absence of business, although it is reported that a fairly good offer was declined over next year by London makers. In crude carbolic, there is scarcely so much inquiry for forward delivery; but business is still brisk at 1s. 6¼d. for January-February.

The average values during the week were: Tar, 23s. 6d. to 28s. 6d. Pitch, London, 43s. to 43s. 6d.; east coast, 42s. 6d. to 43s.; west coast, 41s. to 41s. 6d. Benzol, 90 per cent., 10¾d. to 11¼d.; 50-90 per cent., 8d. Toluol, 7½d. Crude naphtha, 3⅝d.; solvent naphtha, 9d. to 9½d.; heavy naphtha, 10½d. to 11½d. Creosote, London, 1⅝d. to 1 11/16d.; North, 1½d. to 1 9/16d. Heavy oils, 2¼d. to 2⅝d. Carbolic acid, 60 per cent., 1s. 6d. to 1s. 6½d. Refined naphthalene, £5 to £7 10s. Salts, 23s. 6d. to 24s. 6d. Anthracene, "A" quality, 1⅝d. to 1⅞d.; "B" quality, 1d. nominal.

Sulphate of Ammonia.

There has been a fairly steady market during the week, but without much demand for prompt delivery. The South Metropolitan Company are reported to have sold at £12 12s. 6d. for February ship-

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ment, but appear to be fully sold for December-January. Beckton still asks £12 8s. 9d. for December, and £12 12s. 6d. for January-June, which prices buyers decline to pay at present. In Hull, some quantity has been sold at £12 2s. 6d. for December delivery; and there are still buyers at this price. But as regards forward, there is nothing fresh to report. In Leith, £12 2s. 6d. is now the value for prompt, at the equivalent of which it is reported that several parcels have been sold. Makers are reported to have declined £12 7s. 6d. for April-December for a very large quantity. In Liverpool, there is no business to report. The price remains at £12 7s. 6d.

COAL TRADE REPORTS.

Lancashire Coal Trade.

Although the recent spell of severe weather briskened up inquiries for house-fire coals for the time being, it has been of too short duration to have any very really permanent effect. Generally the demand remains indifferent for the period of the year, with many of the collieries still working short time. Prices, although firm, are not more than maintained at late rates. Best Wigan Arley averages 13s. 6d. to 14s. 6d per ton, seconds Arley and Pemberton four feet 11s. and 11s. 6d., to 12s. 6d., and common house-fire coals 9s. 6d. to 10s. 6d. With regard to the lower descriptions of round coal, the tendency is, if anything, towards a slackening inquiry. Prices remain weak and low; common sorts of steam and forge coals being obtainable at 7s. 9d. to 8s. 3d. per ton at the pit, with better qualities quoted 9s. 6d. to 9s. 9d. Engine fuel, except that the better sorts of slack are in active demand and not at all plentiful, is scarcely maintaining the improvement recently noticeable; the commoner descriptions of slack being very plentiful on the market, and offered for clearance at low-cut rates. Prices for the best sorts are firm at 6s. 3d. up to 6s. 6d. and 6s. 9d. per ton at the pit, medium sorts average 5s. to 5s. 6d., and common slack 4s. to 4s. 6d. Shipping shows some slight improvement, and not quite such low prices are being quoted; 9s. to 9s. 3d. being the average figures for medium, up to 9s. 9d. to 10s. for the better qualities of steam coal delivered at the ports on the Mersey.

Northern Coal Trade.

There has been some interruption in the coal trade to the regular shipment, because of the delay of steamers by the storms. The steam coal collieries have felt this in one sense the least, because it is the dullest season of the year with them. Steam coals, however, are lower in price, and best Northumbrian kinds are now from 9s. 6d. to 9s. 7½d. per ton f.o.b., second-class steams are from 8s. 3d. to 8s. 6d., and steam smalls 4s. to 4s. 3d. There has been a little further working, as steamers have arrived more freely. In the gas coal trade, the demand is now heavy, this being the period of the fullest consumption; while the nature of the weather has tended to enlarge the use. Durham gas coals, for occasional cargoes, vary in price from 8s. to 9s. per ton f.o.b., according to quality. The contracts that are being made for next year's exports are at rates between these figures, and do not seem at the present to be for large quantities. Gas coke, with a very full production, is irregular in price, from 14s. to 14s. 6d. per ton having been quoted—a price that is relatively high at present.

Scotch Coal Trade.

The demand does not improve, neither do prices; and the prospect is no brighter than it has been, except, it may be, for house coal, which, on account of the cold weather, is in greater request. The prices quoted are: Main 7s. 6d. to 7s. 9d. per ton f.o.b. Glasgow, ell 8s. 6d. to 9s. 6d., and splint 9s. 3d. to 9s. 6d. The shipments for the week amounted to 222,060 tons—a decrease of 24,379 tons upon the previous week, and of 23,462 tons upon the corresponding week of last year. For the year to date, the total shipments have been 10,306,291 tons—an increase of 129,407 tons upon the same period of last year.

Conveyance of Coal at Belfast.—Mr. Dempsey has given the following notice of motion for the next meeting of the Belfast Gas and Electricity Committee: "That this Committee desired a report from the Gas Manager on the present system of conveying coals from vessels to the gas-works, and upon the expense of providing tugs and lighters to be worked by this Committee."

The Second Pipe-Line from Thirlmere.—Good progress is reported by the Water Committee of the Manchester Corporation in the laying of a second line of pipes from Thirlmere to the city; about 36 miles having been laid out of a total of 45 miles. If the present rate of progress is maintained, the new pipe will be ready for use, and conveying water to Manchester, by next Midsummer.

Entertainment to Employees of the South African Lighting Association.—The eighth annual entertainment to the employees of the South African Lighting Association, in celebration of the King's Birthday, attracted a very large attendance to the Town Hall, Port Elizabeth, on the evening of the 10th ult. The interior was brilliantly and tastefully illuminated. Two Lucas lamps, each of 700-candle power, hung from the centre of the ceiling, and clusters of inverted burners—each burner being of 60-candle power—were fixed to the pillar brackets. The stage was lighted by means of "Bijou" inverted burners of 20-candle power, burning 1 cubic foot of gas per hour. The chair was occupied by Mr. W. Arnott, the Association's Manager, who carried through a very varied and enjoyable programme. In the course of a brief address, he furnished some interesting statistics concerning illuminants, and said the Association's output of gas had greatly increased. Seven or eight years ago, when he arrived in the town, they distributed 30 million cubic feet; whereas now the figures reached 80 millions. They were spending a considerable sum in new plant, despite the proposed electric lighting scheme; and their appliances, when completed, would be equal to any in England, and superior to any in South Africa.

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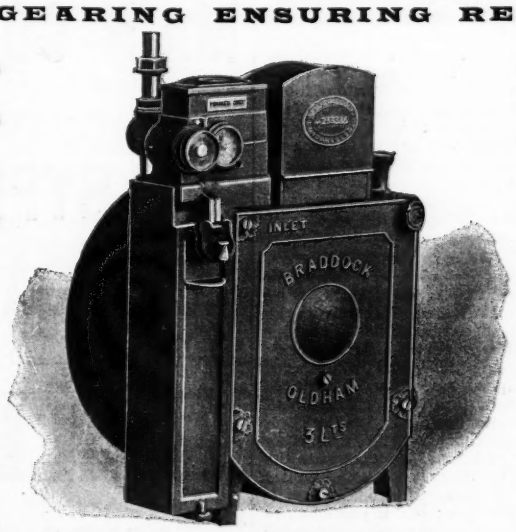

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AND 45 & 47, WESTMINSTER BRIDGE ROAD, LONDON, S.E.

Telegrams: "METRIQUE, LONDON." Telephone No. 248 HOP.

Gas v. Electricity at Southport.—The Southport Corporation Electricity Committee report a total loss of £1600 for the seven months ending October, compared with £1800 at the corresponding period last year. The Gas Committee, on the other hand, report great increases in public and private lighting, in Southport and the out-districts.

Failure of the Electric Light in Pimlico.—"Pimlico in Darkness: Buckingham Palace Without Light."—These were the startling headings to the following paragraph in the "Pall Mall Gazette" on Saturday: "During the height of the fog at the West End to-day, Pimlico was suddenly plunged in darkness, owing to the failure of the electric light. Buckingham Palace was in darkness, and many of the shops were temporarily closed. The Westminster Corporation mitigated the trouble as far as possible by the use of flare-lights in the streets."

The Charge for Gas-Stoves at Rotherham.—Certain recommendations by the Gas Committee in regard to the scale of rents for stoves using gas through an ordinary meter (to come into force on Jan. 1) were the subject of inquiries for explanation at the meeting of the Rotherham County Borough Council last Wednesday. Alderman Gummer stated that those persons who had automatic meters paid 3s. 4d. per 1000 cubic feet, whereas by the ordinary meter the charge was 2s. 9d. It had appeared to the Committee to be unfair that the latter should have the use of cooking-stoves free; and they were proposing to go back to the old system of making a rent-charge for the use of the gas cooking-stoves. The figures had been worked out to give something like a little more than 5 per cent., and to make the charges about equal to the users of both kinds of meters. The recommendations were approved.

Additional Capital for the Maidstone Gas Company.—At the Royal Star Hotel, Maidstone, on the 26th ult., Messrs. J. Tootell and Sons offered for sale, in accordance with the announcement which appeared in our columns, a new issue of £5000 of 5 per cent. capital stock, on which a dividend of £7 12s. 6d. per cent. may be paid, and £2500 of 3 per cent. debenture stock of the Maidstone Gas Company, under the powers conferred by their Act of last session. The capital stock was put up in lots of £100 and less, to suit all classes of investors, and it fetched the following prices: £100 lots, from £136 to £140 (one lot); £50 lots, £67 10s. and £68 (one lot); £25 lots, £33 10s. and £33 15s.; and £10 lots, £13 5s. and £13 10s. The total amount realized was £6783 15s., or at the rate of £135 13s. 6d. per £100 of stock. The debenture stock was placed at an average of £74 14s. 5d. per £100 of stock; realizing £1868. The sale realized £8651.

Portsmouth Water Company.—The half-yearly meeting of the Company was held on Thursday, when the Chairman (Mr. W. Grant, J. P.), in moving the adoption of the report, which was referred to in the "JOURNAL" for the 17th ult., explained that they had had a very successful half year. In the water-rentals there had been an increase of £1635 compared with the corresponding period of last year; and the Resident Engineer (Mr. Herbert Ashley) had effected a saving under the heads of wages and coals. The Directors had for years applied themselves to the work of reducing the waste of water; and he was glad to say that during the six months covered by the report they had effected a saving of 6 gallons per head per diem—from 30 to 24 gallons. He also referred to the excellent additional source of revenue obtained by the laying of the new 20-inch main for the Admiralty to the Dockyard, and bore testimony to the assiduity and ability of Mr. J. L. Wilkinson, the Clerk to the Company, whose salary the Directors had raised from £450 to £500 per annum. Lieut.-Col. C. L. Owen seconded the motion, and it was carried unanimously.

Electric Lighting and the Eyesight.—A correspondent sends us the following statement bearing upon this subject: "The question as to whether gas or electric lighting is most beneficial for the eyes has just been satisfactorily settled, as far as they themselves are concerned, by a class of men to whom the preservation of the sight is of the first importance. These are the envelope addressers. The pay of these men is very small, and, consequently, they have to work long hours—18 out of the 24 is the ordinary scale for five days of the week—in order to earn enough to support them. When the Rowton House at Whitechapel was opened, a number of these men went there. This house is lighted by electricity; and is, as it claims to be, a model poor man's hotel. But the addressers found themselves unable to work on hour after hour as they had done in the houses where gas is in use—the strain caused by the electric light being too trying for the eyes. They therefore had to return to their former residences. I ought to mention that gas is also laid on in the building for use in case of emergency; and it is also employed for culinary purposes."

Devonport Water-Works Arbitration.—We learn from the "Western Morning News" that something like consternation was caused in Devonport on Tuesday by the receipt of a telegram from London announcing the death of Sir Frederick Bramwell, who, it may be remembered, was the Umpire in the arbitration proceedings in connection with the proposed transfer of the water-works from the Company to the Corporation. The arbitration proceedings were held last March, and were of considerable length. Subsequently questions of law were raised by the Corporation, on whose application the Arbitrators and Umpire consented to state a special case for the opinion of the High Court. On the application of the Water Company, the arbitration tribunal again sat in August for hearing additional evidence as to the obligations of the Company with regard to the water supply to Admiralty property. The original intention was that the award should be available for either side to take up on the 30th of June; but, in consequence of the proceedings subsequent to the arbitration, the time was extended to the 31st of October. Early in November, however, it was ascertained that the award was not ready, as the Arbitrators had been unable to agree; and the final decision as to the specific terms upon which the undertaking should be transferred had to be made by the Umpire. There was, therefore, a general impression that the award could not be taken up until after Christmas. The unfortunate death of Sir Frederick Bramwell may necessitate a repetition of the whole of the arbitration proceedings unless the parties agree to appoint an Umpire to decide the terms of purchase after reading all the documents and reports bearing upon the matter.

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Quotations cheerfully given for all kinds of Gas Fittings.

A Willing Corporation Gas Committee.—On the proposition of the Gas and Electric Committee, the Belfast Corporation have consented to a sum not exceeding £3000 of the undisposed profits of the gas undertaking, 1902-3, being placed at the disposal of the Library and Technical Instruction Committee, for the purpose of purchasing three sites for proposed Carnegie branch libraries.

Incandescent Gas Lighting for London Schools.—At the weekly meeting of the London School Board on Thursday, the Works Committee reported that they had decided to provide incandescent burners in future in all new schools, as well as in the case of enlargements in the new rooms, and in any room in the old portion of a school where for other purposes the lighting has to be altered.

Gas-Meters as Savings Banks.—It is pretty generally known that in many households the penny-in-the-slot gas meter is now being utilized as a savings bank. By dropping in a florin, a pennyworth of gas is obtained, while 1s. 11d. goes to the credit of the consumer. It is reported that an inspector not long ago found 42 florins and 10 pennies in a meter, representing 4s. 4d. worth of gas. The balance, £4 0s. 6d., was handed back to the householder, who remarked that this was the only way in which he was able to keep money.

Walker and Wallsend Union Gas Company.—An extraordinary general meeting of the Company was held on Friday—Colonel Crawford in the chair. The Company's new Act was submitted, and the Chairman explained its principal provisions. He said the present capital of the Company amounted to £59,255, and this, under the new powers, was to be converted into £118,510. The additional capital which the Company were authorized to raise was £120,000, to be divided between ordinary and preference stock. The shareholders were asked to sanction the raising of £12,000 of new ordinary stock, £12,000 of new preference stock (the latter bearing a fixed dividend of 5 per cent.), and one-third of these two sums, or £8000, by loans. From the December readings of the meters, the price of gas to ordinary consumers would be reduced from 2s. 6d. to 2s. 3d. per 1000 cubic feet. This reduction would increase the shareholders' dividends under the present conditions to 10 per cent., from which, however, must be deducted ½ per cent., owing to the provision for the supply of 14-candle gas. The dividend available upon the charge of 2s. 3d. was therefore 9⅜ per cent. This year the sale of gas was estimated to reach 210 million cubic feet. The Chairman concluded by moving a formal resolution authorizing the creation of the new stock. Alderman G. A. Allan, the Vice-Chairman, seconded the proposal, and it was agreed to.

According to a Reuter telegram, dated the 2nd inst., from Bukarest, the two representatives of the Standard Oil Company who have been engaged in investigations regarding the Rumanian oilfields have returned there, and registered their firm in the local Commercial Court; the Company having decided to exploit the petroleum fields.

Tenders at and above the minimum price of £180 per cent. for the purchase of £9785 of consolidated "C" ordinary stock of the Croydon Gas Company (recently invited in our advertisement columns) were received on Wednesday at the offices of the Company; and tenders for £5000 of the stock, at an average price of £186 15s. 6d. per £100, have been accepted.

The Cheadle Water-Works Company has been registered with a capital of £4500, in £10 shares. It is a re-incorporation as a limited Company, under the Companies Acts 1862 to 1900, of the Cheadle Water-Works Company, Limited, which was originally constituted by Deed of Settlement dated June 10, 1854, and registered pursuant to the Joint-Stock Companies Act on Oct. 23, 1856.

We have on several previous occasions mentioned approvingly Calvert's "Mechanics' Almanack and Workshop Companion." It is a year-book compiled expressly with the view of meeting the requirements of artisans and handicraftsmen; and the 31st issue, which we have just received from the Publisher (Mr. John Heywood, of Manchester and London), is replete with useful notes, facts, and data for all who are engaged in offices or works.

At the last monthly meeting of the Goole Urban District Council, the Chairman of the Gas and Water Committee (Mr. T. C. Turton) brought up a motion to increase the salary of Mr. T. E. Franklin, the Gas and Water Manager, by £75 per annum. Appreciative references to Mr. Franklin's work were made by the mover, as well as by the Chairman of the Council (Mr. A. Blyth); and though the proposed advance was opposed by certain members, the motion was carried by eight votes to five.

At the last monthly meeting of the Birkenhead Town Council, the salary of Mr. S. Tagg, the Assistant Works Engineer, was increased by £75 per annum. Mr. Tagg's progress since he has been in the service of the Corporation has been rapid. He started on weekly wages in 1898; the next year he was appointed Chemist and Draughtsman; last year he was promoted to the position of Assistant Works Engineer, with an increased salary; and now he has been raised higher on a rearrangement of the staff.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

ASSISTANT-MANAGER. Clonmel Gas Department. Dec. 22.
APPRENTICES TO GAS ENGINEERING CONTRACTORS. No. 4132.
RENTAL CLERK, &c. No. 4134.
JUNIOR CLERK (LONDON). "Accountant," Great Winchester Street, E.C.
GENERAL FOREMAN. No. 4133.
MECHANIC FOR NEW ZEALAND. Terry & Co., London.
FITTERS. Wisbech Gas-Works.

Situations Wanted.

ASSISTANT-MANAGER. No. 4135.
GASFITTER. Cedar Road, Southampton.
REPRESENTATIVE OF GAS ENGINEERING FIRM. No. 4136.

Plant (Second-Hand) Wanted.

WASHER (Livesey), PURIFIER, CONDENSERS. No. 4131.

Plant for Sale.

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STATION METER. Shepshed Gas-Works.

Sales of Stocks and Shares.

KENT WATER-WORKS COMPANY. Dec. 15.
NORTH MIDDLESEX GAS COMPANY. Dec. 29.
PORTSMOUTH WATER COMPANY. Jan. 21.

TENDERS FOR

Coke and Breeze.

SWANSEA GAS-WORKS.

Pipes and Specials.

STOCKPORT GAS DEPARTMENT. Tenders by Dec. 16.
LEIGH (LANCS.) WATER DEPARTMENT. Tenders by Dec. 10.
LEICESTER CORPORATION. Tenders by Dec. 12.

Portland Cement.

EDINBURGH AND LEITH GAS COMMISSIONERS. Tenders by Dec. 14.

Purifiers.

PONTYPRIDD GAS DEPARTMENT. Tenders by Dec. 21.

Retort Installation (Inclined).

MANCHESTER GAS DEPARTMENT. Tenders by Jan. 7.

Steel Rails.

EDINBURGH AND LEITH GAS COMMISSIONERS. Tenders by Dec. 14.

Tar.

CANTERBURY GAS AND WATER COMPANY.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

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SPECIALLY prepared for the Manufacture of SULPHATE OF AMMONIA.

SPENCER, CHAPMAN, AND MESSEL, LIMITED, 36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.

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SULPHURIC ACID for Sale, specially suitable for making Sulphate of Ammonia.

BROTHERTON AND CO., LTD., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHATE OF AMMONIA

SATURATORS and LEAD WORK for Sulphate of Ammonia Plants.

For REPAIRS or ALTERATIONS, ring up "0848 BOLTON," or Telegraph "SATURATORS, BOLTON."

Largest Practice and most Up-to-Date Works in Britain.

JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS, BOLTON.

"NUGEPE" CEMENT.

JOHN E. WILLIAMS AND CO.,

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For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

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HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.

Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.

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AMMONIACAL LIQUOR wanted.

BROTHERTON AND CO., LTD., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PENNY-IN-THE-SLOT WORK.

H. GREENE & SONS, Ltd., are prepared to give QUOTATIONS to Gas Companies or Corporations for FITTING UP COMPLETE and CARRYING OUT the WORK in its entirety, either in Iron or Compo.

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Telephone: 1693 HOP. Telegrams: "LUMINOSITY."

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PUBLICATIONS. "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; "SUBJECT-MATTER of PATENTS," 6d.

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THE Applicants for the position of FOREMAN STOKER at the Brentwood, Essex, Gas-Works are THANKED. The vacancy IS NOW FILLED.

ROBERT M. COUPER,
Manager.

GAS-FITTER wants Situation. Used to all branches in Fitting Department, Slot Work, Cookers, Incandescent Burners, and Service Laying. Can read and fix Meters. Willing to take position as Inspector. Trustworthy. Age 28. Abstainer.

Address 30, Cedar Road, SOUTHAMPTON.

WANTED, a Situation as Assistant-MANAGER. Four-and-a-half Years' Experience with a Western Gas Company. Well up in Photometry, Testing for Impurities, and the General Routine of a Gas-Works. Age 21. Articled.

Address No. 4135, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

A GENTLEMAN, who has represented a well-known Firm of Gas Engineers for over Ten Years, seeks change. Very well known and popular among the Profession, Surveyors, Architects, and Builders, and can introduce a unique connection in Railway Work.

Address No. 4136, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TWO Apprentices wanted by a Firm of Contracting Gas Engineers. Must be well Educated.

Apply, giving full Particulars, to No. 4132, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SECRETARY requires a Junior Clerk in London (City) Office. Good hand-writing indispensable. Must be quick at figures. Preference given to one used to Gas Office Routine. State Age, Salary, &c.

Address, "ACCOUNTANT," 5, GREAT WINCHESTER STREET, E.C.

WANTED, at once, for a Gas Company near London, an experienced GENERAL FOREMAN, able to undertake the repairing of plant, &c. Make 90 Million cubic feet. Wages £2 per week.

Further Particulars on application to No. 4133, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WISBECH GAS-WORKS.

WANTED, several good Fitters used to Iron and Compo. Only steady, good workmen need apply.

J. G. HAWKINS,
Manager.

WANTED, immediately, in a Gas Company's Office near London, a RENTAL CLERK experienced in Ledger work, Wages Book, and usual Office routine. Knowledge of Shorthand desirable. Salary 3⅓s. per week.

Applications, stating Age and Experience, to be sent to No. 4134, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED for New Zealand, a First-Class MECHANIC. Must have served his time with a First-Class Engineer. Must be able to attend to, and repair, the Machinery in a Modern Gas-Works, equipped with all labour-saving appliances. Wages 10s. per day. Two Years' agreement. Age from 25 to 30. Only those having the necessary Experience need apply.

Apply, by letter only, to JOHN TERRY AND CO., 7, GREAT WINCHESTER STREET, E.C.

CORPORATION OF CLONMEL.

WANTED, by the Gas Committee of the Corporation of Clonmel, a smart, intelligent, young man, as ASSISTANT MANAGER of their Gas-Works, at a Salary of £120 per annum. None but those who have had practical experience in the Working and Management of Sulphate of Ammonia Plant need apply. A good knowledge of Chemistry and Mechanical Drawing indispensable.

Applications, endorsed "Assistant Manager," stating Age, Experience, and accompanied by *copies* only of not more than Three recent Testimonials, to be sent to Thomas Phelan, Esq., Spring Garden, Clonmel, so as to reach him not later than the 22nd of December next.

Statement of Duties and Terms of Appointment can be obtained on Application to the undersigned.

J. F. O'BRIEN,
Town Clerk.

Clonmel, Nov. 28, 1903.

WANTED, a Second-Hand Livesey WASHER for Works making about 20 Million cubic feet per annum; also Second-Hand PURIFIER (8ft. to 10ft. square), with or without Valves and Connections.

Also, a Set of Annular or Battery CONDENSERS, capable of dealing with a maximum of 10,000 cubic feet of gas per hour.

Address No. 4131, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

1500 Feet Cowan Station Meter, with 4-inch Connections and Bye-Pass Valves, in Good Working Order, FOR SALE.

SHEPSHED GAS-WORKS, LEICESTERSHIRE.

TO BE SOLD — Twin-Cylinder Gas-ENGINE, 6 n.h.p., by Crossley; Cylinders 8 in. diameter by 18 in. stroke, and Gas-Bag.

NEW GASHOLDER SHELLS, 40 feet diameter by 12 feet deep, and 50 feet diameter by 15 feet deep, with or without New Steel Tanks and Standard Guides.

Write J. WRIGHT, 181, Queen Victoria Street, LONDON, E.C.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.

J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

TO MALSTERS, CEMENT AND BRICK MANUFACTURERS, LIME BURNERS, AND OTHERS.

BEST Screened Gas Coke and Breeze FOR SALE.

Wholesale Prices can be obtained at the GAS-WORKS, SWANSEA. By Shipment or by Rail direct.

WANTED, Offers for the following

Second-Hand GAS PLANT:—

30 ft. of W.I. HYDRAULIC MAIN, 24 in. by 24 in.
22 ft. 6 in. of W.I. HYDRAULIC MAIN, 18 in. by 16 in.
21 ft. 6 in. of W.I. HYDRAULIC MAIN, 16 in. by 14 in.
22 ft. 8 in. of C.I. HYDRAULIC MAIN, 14 in. by 14 in.
21 C.I. MOUTHPIECES (⏀'s), 21 in. by 15 in.
45 C.I. MOUTHPIECES (oval), 21 in. by 15 in.
21 ARCH-PIPES, 6-inch.
90 ARCH-PIPES, 4-inch.
15 ARCH-PIPES, 3-inch.
21 ASCENSION-PIPES, 6-inch.
45 ASCENSION-PIPES, 5 in. by 4 in.
12 C.I. HYDRAULIC MAIN STANDS.
36 SIGHT-BOXES, 4 in. by 4 in.
One HYDRAULIC SEAL VALVE, 8-inch.

The above may be viewed at the Works of the Brentwood Gas Company.

Offers to be addressed to

C. A. FIELDER,
Secretary.

Gas Offices, Brentwood, Essex,
Dec. 3, 1903.

TAR Contracts Wanted on the Sliding-Scale or at Fixed Prices.

Managers and Secretaries desirous of selling to best advantage please communicate with DENT AND CO., Ouse Chemical Works, SELBY.

CANTERBURY GAS AND WATER COMPANY.

TO TAR DISTILLERS.

OFFERS are invited for the Company's surplus TAR during the year 1904. The price to be stated at per gallon in the Contractor's barrels free on Rail at Canterbury.

Canterbury, Dec. 3, 1903.

BOROUGH OF LEIGH.

(WATER DEPARTMENT.)

THE Gas and Water Committee of the above Corporation invite TENDERS for the supply and delivery of about 3000 yards of 16-inch diameter Cast-Iron Socket and Spigot PIPES and SPECIALS.

Specification, Forms of Tender, and any further Particulars may be obtained on application to the Engineer, James Gibson, Esq., Gas and Water Works Offices, Leigh, Lancashire.

Sealed Tenders to be delivered to me the undersigned not later than Twelve o'clock noon on Thursday, the 10th day of December, 1903.

Tenders to be endorsed "Tender for 16-inch Pipes."

By order,
PEREGRINE THOMAS,
Town Clerk.

Town Hall, Leigh, Lancs.
Dec. 3, 1903.

MANCHESTER CORPORATION.

(GAS DEPARTMENT.)

TO CONTRACTORS FOR INCLINED-RETORT INSTALLATIONS.

THE Gas Committee are prepared to receive TENDERS for an installation of INCLINED RETORTS, to be constructed and set to work at their Gaythorn Station.

Specification and Tender Form may be obtained on application to Mr. C. Nickson, Superintendent, Gas Department, Town Hall, on payment of Two Guineas, which will be returned on receipt of a *bonâ-fide* Tender.

Drawings may be seen, and any other Information obtained, on application to Mr. J. G. Newbigging, C.E., at his Office, Rochdale Road Station.

The Committee do not bind themselves to accept the lowest or any Tender.

Sealed Tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Installation of Inclined Retorts," must be delivered at the Gas Offices, Town Hall, Manchester, not later than Ten a.m., on Thursday, the 7th of January, 1904.

WM. HENRY TALBOT,
Town Clerk.

Town Hall, Manchester,
Dec. 4, 1903.

EDINBURGH AND LEITH CORPORATIONS' GAS COMMISSIONERS.

TO RAILWAY RAIL CONTRACTORS.

THE Commissioners are prepared to receive TENDERS for the supply of from 250 to 300 Tons of New Double-Headed STEEL RAILS, weighing 75 lbs. per lineal yard, in lengths of from 24 to 30 feet, delivered at their Railway Sidings, New Gas-Works, Granton, near Edinburgh (Caledonian or North British Railway Systems), or free on rail at Leith or Granton Harbours.

Deliveries to be commenced immediately after acceptance of Offer, and to extend over a period of Three Months.

Full Particulars and Section of Rail can be obtained upon application to Mr. W. R. Herring, M.Inst.C.E., Chief Engineer and Manager, New Street Works, Edinburgh.

Tenders to be lodged with the Undersigned on or before Monday, the 14th day of December, 1903, not later than Ten a.m., sealed and endorsed "Tender for Railway Rails."

The Commissioners do not bind themselves to accept the lowest or any Offer, and reserve to themselves the right of accepting the whole or a portion of the material tendered for.

JAMES M'G. JACK,
Clerk.

25, Waterloo Place, Edinburgh,
Nov. 16, 1903.

EDINBURGH AND LEITH CORPORATIONS' GAS COMMISSIONERS.

THE Commissioners are prepared to receive TENDERS for the supply of 4000 to 5000 Tons of Best Quality Fine Ground Medium Quick-Setting PORTLAND CEMENT, delivered in Bags *ex.* ship into Railway Waggons, Granton Harbour, or on rail at the Sidings, New Gas-Works, Granton, near Edinburgh (Caledonian or North British Railway Systems.)

Deliveries to commence in the beginning of 1904 and extend over a period of about Three Years in quantities of from 200 to 300 Tons.

Full Particulars can be obtained on application to Mr. W. R. Herring, M.Inst.C.E., Chief Engineer and Manager, New Street Works, Edinburgh.

Tenders to be lodged with the undersigned on or before Monday, the 14th day of December, 1903, not later than Ten a.m., sealed and endorsed "Tender for Portland Cement."

The Commissioners do not bind themselves to accept the lowest or any Offer, and reserve to themselves the right of accepting the whole or a portion of the material tendered for.

JAMES M'G. JACK,
Clerk.

25, Waterloo Place, Edinburgh,
Nov. 16, 1903.

PONTYPRIDD URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply, delivery, and erection of Two Luteless PURIFIERS, 24 feet Square, with Valves, Connections, &c., at their Treforest Gas-Works.

Plans and Specifications, with Form of Tender, may be seen at the Gas Offices, Treforest, on application to the Engineer, Mr. Edward Jones.

Tenders, sealed and endorsed "Purifiers, Contract No. 12," to be sent not later than the 21st of December, 1903, addressed to the undersigned.

The Committee do not bind themselves to accept the lowest or any Tender.

J. COLENSO JONES,
Clerk.

Council Offices, Pontypridd.

COUNTY BOROUGH OF STOCKPORT.

TO IRONFOUNDERS.

THE Gas and Electricity Committee are prepared to receive TENDERS for a supply of 3-inch and 4-inch Cast-Iron MAINS and for IRREGULARS from 3-inch to 6-inch.

Specifications and Particulars can be obtained from the Engineer, Mr. S. Meunier.

Tenders, endorsed "Mains," must be addressed to the Chairman of the Gas and Electricity Committee, Stockport, on or before Dec. 16 next ensuing.

No Tender will be accepted without satisfactory proof that the firm tendering pays the Trade Union rate of wages, and observes the Trade Union number of hours as are usually paid and observed in the district where the goods are made or produced.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
ROBERT HYDE,
Town Clerk.

Stockport, Dec. 1, 1903.

CORPORATION OF LEICESTER.

CAST-IRON PIPES.

THE Gas and Electric Lighting Committee of the above Corporation are prepared to receive TENDERS for the supply and delivery of the necessary CAST-IRON PIPES and CONNECTIONS, from 2 to 36 inches in diameter, required during the Twelve Months ending the 31st of December, 1904.

Specification and Form of Tender may be obtained upon application to the Engineer.

Tenders, addressed to Mr. Councillor Edwards, Chairman, and endorsed "Tender for Cast-Iron Pipes, &c.," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, Dec. 12, 1903.

The Committee do not bind themselves to accept the lowest or any Tender.

ALFRED COLSON, M.Inst.C.E., M.Inst.E.E.,
Engineer and Manager.

Offices: Millstone Lane,
Leicester, Dec. 4, 1903.

NORTH MIDDLESEX GAS COMPANY.

SALE BY TENDER OF
£3000 FIVE PER CENT. PREFERENCE STOCK
AND 300 SEVEN PER CENT. ADDITIONAL
ORDINARY SHARES OF £10 EACH.

NOTICE is Hereby Given, that the Directors of the North Middlesex Gas Company will offer the above Stock and Shares for SALE BY TENDER during the ensuing period ending the 29th of December, 1903, the last day for the reception of Tenders being Tuesday, the 29th of December, 1903.

Particulars of the Sale and Forms of Tender may be had on Application to the undersigned, or at the District Office of the Company, No. 11, The Broadway, Church End, Finchley.

By order,
ERNEST L. BURTON,
Secretary.

Secretary's Office:
5 & 6, Great Winchester Street,
Old Broad Street, London, E.C.
Nov. 27, 1903.

KENT WATER-WORKS COMPANY.

SALE BY TENDER OF THREE PER CENT.
DEBENTURE STOCK.

THE Directors invite Tenders for such amount of THREE PER CENT. DEBENTURE STOCK, or of any portion thereof, being a multiple of £10, as may in the whole be sufficient to realize the sum of £74,147 6s. 7d., being the balance of the Capital authorized to be raised under the provisions of the Kent Water-Works Act, 1902.

This Stock may be redeemed at par by the Company at any time after the expiration of 25 Years from the date of issue upon Six Months previous notice to the registered holders thereof. It ranks *pari passu* with the other Debenture Stocks of the Company for the payment of interest.

The Ordinary Capital of the Company raised is £868,000, which comprises £708,000 Capital Stock, on which a dividend of 10 per cent. per annum was paid on the Half Year to Midsummer, 1903, and £160,000 new Capital Stock, on which the full dividend of 7 per cent. has been paid since its issue.

The Loan Capital raised is £273,512—viz., £42,000 by Mortgages, and £231,512 by Debenture Stock.

This Stock is an authorized investment for Trustees.

Forms of Tender, with Particulars and Conditions, may be obtained on application to the Secretary.

Tenders to be sent in on or before Tuesday, the 15th of December.

By order of the Directors,
A. DICKSON, jun.,
Secretary of the Company.

Kent Water-Works Offices:
Mill Lane, Deptford, S.E., Nov. 14, 1903.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of the Company, so far as they relate to DEBENTURE STOCK, WILL BE CLOSED at Ten o'clock forenoon on Friday, the 11th of December, for the Half Year ending the 31st of December, 1903, and will be RE-OPENED on Friday, the 18th of December.

The Interest for the Half Year will be payable on the 1st day of January next to the Proprietors registered on the closing of the Books.

By order of the Board,
JAMES RANDALL,
Secretary.

Chief Offices: 639, High Road,
Tottenham, Dec. 4, 1903.

EAST LONDON WATER-WORKS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS in respect both to the Four-and-a-half per Cent. and the Three per Cent. Debenture Stocks, WILL BE CLOSED from the 10th to the 31st of December inst., both days inclusive, and RE-OPENED on the 1st of January, 1904, on which day the Interest Warrants on these Stocks will be payable.

By order,
I. A. CROOKENDEN,
Secretary.

St. Helen's Place,
Bishopsgate Street, E.C.,
Dec. 2, 1903.

BOROUGH OF PORTSMOUTH WATER-WORKS COMPANY.

WATER ORDER, 1902.

THE Directors of the above Company Hereby give Notice, that a SALE by AUCTION of TWO THOUSAND NEW ORDINARY £5 SHARES in the above Company will, under and in pursuance of "The Borough of Portsmouth Water Order, 1902," be held at the Lower Albert Hall, Commercial Road, Portsmouth, by

Messrs. ERNEST SAPP and CO., AUCTIONEERS,

on Thursday, the 21st day of January, 1904, at Seven o'clock in the Evening.

The above Shares, which form part of the New Ordinary Capital authorized to be raised by the said Order, will be sold in Lots, of which the Amounts and Particulars (together with the Conditions of Sale) will be duly announced.

Dated this 26th day of November, 1903.

By order of the Board of Directors,
J. L. WILKINSON,
Secretary to the Company.

Company's Offices, Commercial Road,
Portsmouth.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.

Terms for Issuing such Capital, and also for including Gas and Water Stocks and Shares belonging to Private Owners in these Periodical Sales, can be obtained on application at MR. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

'BUFFALO' INJECTOR

Operated Entirely by One Handle

Class A lifts 24 ft.
Class B lifts 12 ft.

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GREEN & BOULDING,
105, Bunhill Row,
LONDON, E.C.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts, and Covers, and rendering Leakage impossible.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

THOMAS DUXBURY & CO.,

16, DEANSGATE, MANCHESTER,

Gas Engineers' Agents and Contractors for METERS, FIRE-CLAY GOODS, OXIDE OF IRON, AND ALL OTHER GAS APPARATUS.

Inquiries Solicited.

Telegrams: "DARWINIAN, MANCHESTER." Telephone 1806.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY
RAVENSTHORPE, NEAR DEWSBURY.

HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas.

Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.,

CHESTERFIELD.

THE

PETROLEUM GAS SYNDICATE

Supply and erect Complete Installations of their

PETROGENE PATENT GAS PLANT

On SALE, HIRE, or ROYALTY.

PETROGENE GAS is the most suitable Illuminant for all Towns, Villages, Factories, Institutions, &c., where a Cheap and Efficient Lighting System is required. It is equally suitable for Heating and Power purposes, and may be used with ordinary Gas Fittings, Stoves, Engines, &c. It may also be used in conjunction with Coal Gas, and affords Gas Companies a ready means of increasing their output without the expense of additional storage.

The Syndicate is prepared to entertain offers of sale of small Gas-Works, whether profit earning or not.

Offices: 28, Victoria St., Westminster.
Works: 10, Rochester Row, S.W.

JOHN HALL & CO.,

STOURBRIDGE,

Manufacturers of

FIRE-BRICKS, LUMPS, TILES,

GAS RETORTS,

And every description of Fire-Clay Goods.

RETORTS CAREFULLY PACKED FOR SHIPMENT.

TROTTER, HAINES, & CORBETT, LIMITED,
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FIRE-CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Special Lumps, Tiles, and Bricks for Regenerative and Furnace Work.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.
LONDON OFFICE: R. CULL, 34, OLD BROAD STREET, E.C.

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LOW OR HIGH PRESSURE PACKING
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Ask for No. 1 Catalogue.
Applications for Colonial & Foreign Agencies invited.
CRESSWELL'S ASBESTOS CO., LTD.,
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MANUFACTURERS OF THE WELL-KNOWN
SUPERIOR "PERMCO"
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Trade Price 26s. 6d. per Gross.
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"ROTARY"
STATION METER.
Efficiency Demonstrated.
APPLY—
T. G. MARSH,
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WELDON MUD
FOR
GAS PURIFICATION,
For use in the
RECOVERY OF SULPHUR,
Also Removal of last Traces of
SULPHURETTED HYDROGEN
in catch position.
Full Particulars on application to the Patentees:
GAS DESULPHURIZATION CO.,
— LIMITED, —
1, FENCHURCH AVENUE, LONDON, E.C.

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PATENTS.
BURNERS
DUST AND INSECT PROOF.
PATENT LAMPS for INTERIOR LIGHTING.
Suitable for
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Can also be made as Ventilating Lights for Public Halls and Private Rooms.

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Can be adjusted to suit any Quality of Gas.
The highest efficiency yet obtained from Low-Pressure Incandescent Gas Lighting without mechanical aid.
Our full Catalogue is now ready illustrating various Designs of our Patent System up to any Power.
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25a, HATTON GARDEN, E.C.
Telephone No. 6600 CENTRAL.
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THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.
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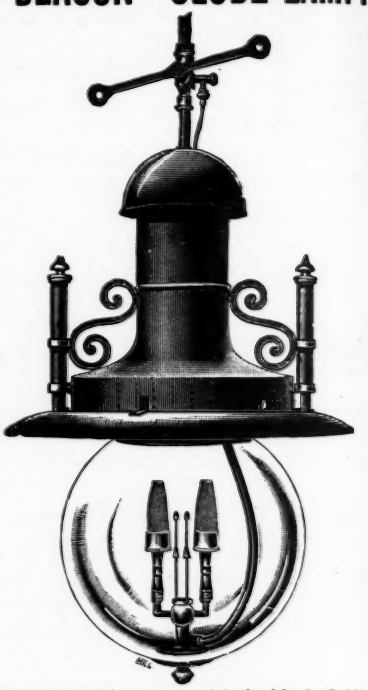

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H. GREENE & SONS, Limited,
Surrey Engineering Works,
Blackfriars Road, LONDON.
Telephone 1693 HOP.
Telegrams: "LUMINOSITY LONDON."

COAL TAR PRODUCTS.

Benzol, Toluol, Solvent Naphtha, Creosote Oils, Grease Oils, Carbolic Acid, Crude Creosote Salts, Granulated (Crude) Naphthalene, Sublimed Naphthalene, Anthracene, Refined Tar, Pitch, also Sulphate of Ammonia.

For Prices apply to the **SOUTH METROPOLITAN GAS COMPANY,**
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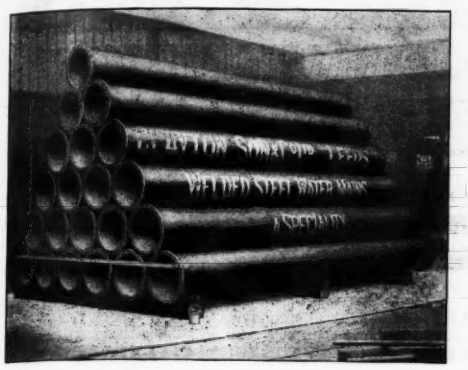
EAST GREENWICH, LONDON, S.E. Telegraphic Address: "METROGAS, LONDON."



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CONSEQUENT UPON THE "A1" QUALITY THEY SUPPLY.

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FOR ALL TYPES OF
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Price 0d

No. 21.] [*Tuesday, December 8, 1903.*

Wanted

We should be delighted if readers of these lines would kindly communicate to us any particulars of noteworthy Lucas Light installations, as well as details of any exceptional uses to which it has been put by them. Among the many thousands of Lucas Lamps burning in these Isles, there must be a goodly number grouped in larger systems for lighting public buildings, including town halls, libraries, and exhibition rooms, and for workshop and warehouse illumination on a larger scale. This enumeration, of course, does not exhaust the possible list, and we shall expect to hear about larger installations for inside and outside shop lighting, and also for the illumination of open spaces.

The Outsider's View

Thus the "Plumber and Decorator" in a recent issue: "Only those who know the conservatism of the British character will appreciate the whole magnitude and expense of the undertaking, and we trust that no one will begrudge them their well-merited success. The Lucas Lamp, as it is now on the market, is not an experiment, but an unqualified success."

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The "LANCET" of the 24th of January, 1903, published the Report on this new system of producing radiant heat from Gas, by the introduction of vapour into hot Gases, for the purpose of increasing expansion, by which the same kind of Heat is produced as by the Electric current, at one-tenth of the cost. These Stoves are constructed of Cast Iron without any Sheet Metal Tubes, and supplied black or enamelled in colours.

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SIZE—1 ft. 9 in. wide, 3 ft. high, 7 in. deep.

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Do. with Polished Brass Ornament and Electro-Bronzed Panel	4 0 0
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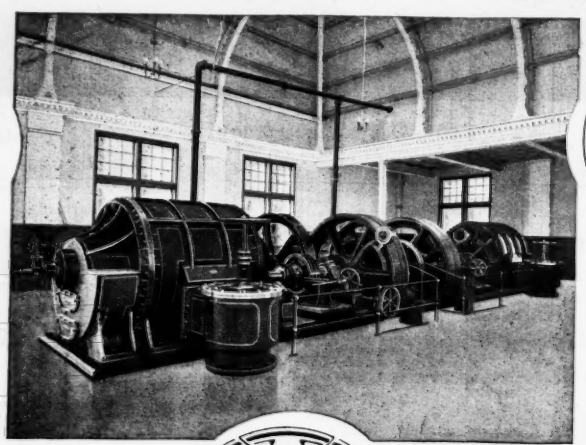

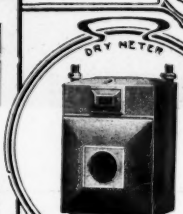

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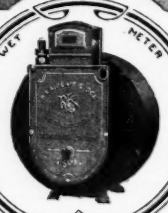

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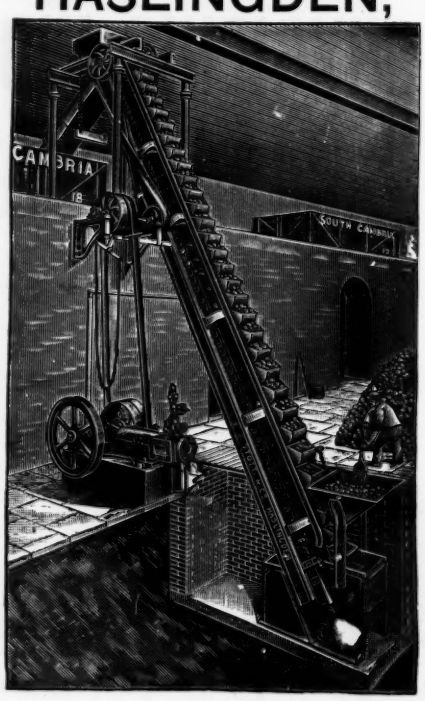

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3 gallons Tar and 20 lbs. Coke produce 1000 cubic feet 10 to 12 Candle Power Gas of the following composition—

Hydrogen	64·4 per cent.
Methane	12·0 „ „
Unsaturated Hydrocarbons	3·0 „ „
Carbon Monoxide	15·0 „ „
Nitrogen and Carbon Dioxide	5·6 „ „
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Calorific Value	400 B.T.U.

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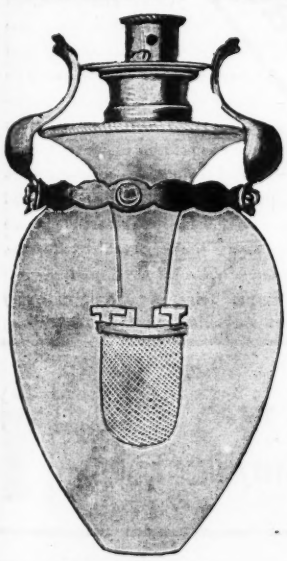

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Globes from **8d.** each.

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Gas Consumption only 3 cubic feet per hour.

The decorative appearance of Electric Light at one-tenth the cost.

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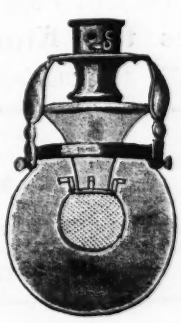

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One-third full size.
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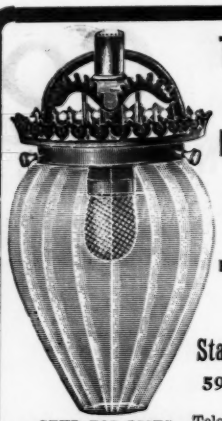

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Gas Consumption of 2½ cubic feet per hour.
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Supersedes Electricity.
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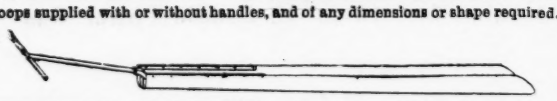
Scoops supplied with or without handles, and of any dimensions or shape required.



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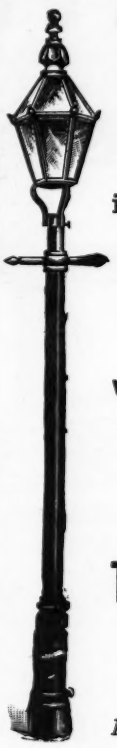

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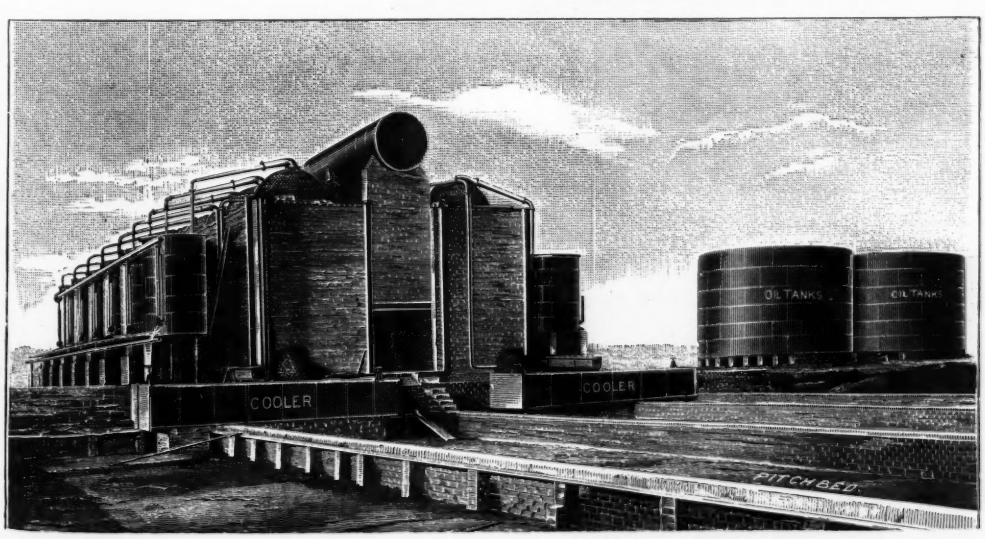

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